

THE
POWERS OF THE CREATOR
DISPLAYED IN THE CREATION.

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W. SMELLIE WATSON R.S.A.

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SIR JOHN



GRAHAM DALRYMPLE

Knight and Baronet of Buns

THE
POWERS OF THE CREATOR
DISPLAYED IN THE CREATION;

OR,
OBSERVATIONS ON LIFE AMIDST THE VARIOUS FORMS
OF THE
HUMBLER TRIBES OF ANIMATED NATURE:

WITH
PRACTICAL COMMENTS AND ILLUSTRATIONS.

BY
SIR JOHN GRAHAM DALYELL,
KNIGHT AND BARONET,

TO WHICH IS PREFIXED,
A MEMOIR OF THE AUTHOR.

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CONTAINING
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1. The first part of the report is a general introduction to the subject of the study. It discusses the importance of the study and the objectives of the research. It also provides a brief overview of the methodology used in the study.

2. The second part of the report is a detailed description of the study area. It includes information about the location of the study area, the population of the study area, and the characteristics of the study area.

3. The third part of the report is a description of the data collection process. It includes information about the sources of data, the methods used to collect data, and the procedures used to ensure the accuracy of the data.

4. The fourth part of the report is a description of the data analysis process. It includes information about the statistical methods used to analyze the data, the results of the analysis, and the conclusions drawn from the analysis.

5. The fifth part of the report is a conclusion and a discussion of the findings of the study. It includes a summary of the main findings of the study, a discussion of the implications of the findings, and a list of recommendations for further research.

6. The sixth part of the report is a list of references. It includes a list of all the sources of information used in the study, including books, articles, and other documents.

7. The seventh part of the report is an appendix. It includes a list of all the data collected during the study, including raw data and data that have been analyzed.

8. The eighth part of the report is a list of figures and tables. It includes a list of all the figures and tables included in the report, including a list of the data used in each figure and table.

9. The ninth part of the report is a list of abbreviations. It includes a list of all the abbreviations used in the report, including a list of the full names of the abbreviations.

10. The tenth part of the report is a list of symbols. It includes a list of all the symbols used in the report, including a list of the full names of the symbols.

11. The eleventh part of the report is a list of acknowledgments. It includes a list of all the people and organizations that have provided assistance or support during the study.

12. The twelfth part of the report is a list of appendices. It includes a list of all the appendices included in the report, including a list of the data used in each appendix.

MEMOIR
OF
SIR JOHN GRAHAM DALYELL,
KNIGHT AND BARONET.

THE family of Dalyell of Binns, in Linlithgowshire, is of ancient standing. They are the heirs-male of the Menteths, Earls of Menteth, of whose descent it will be necessary to give a brief outline.

The name Menteth is local. There is an extensive district in Scotland through which the river Teth runs, called the Stewartry of Menteth. The orthography in which we have found it, is Menethet, Menteth, Monteith, Monteith, which last is the most recently adopted.

If historians be credited, there are few titles of more ancient date than the Earldom of Menteth. Some of them affirm, that there was an Earl of that name in the reign of Malcolm the Third, who succeeded to the throne in 1056, and was killed in 1093 ; and, not many years afterwards, during the reign of his son, David, the existence of Murdac, Earl of Menteth, is proved by authentic documents. In the course of the thirteenth century, we have also evidence of Gilchrist and Maurice being successively Earls of Menteth.

Walter, third son of Walter, Lord High Steward of Scotland, married the descendant of one of these Earls, and, from the course of the succession afterwards, perhaps obtained on that event new investitures of the title to heirs-male. His name frequently appears in the transactions of the thirteenth century. He was present at the battle of Largs, in 1263 ; and in 1291 was one of the arbiters on the part of Robert Bruce,

in his claim to the crown of Scotland. At an advanced age he participated in the wars with the neighbouring country, and, in conjunction with other leaders, entered the English frontier in 1296.

The Scots then assaulted Carlisle, and set the town on fire, but were compelled to a speedy retreat by the vigour and courage of the inhabitants. King Edward the First, in return, levied an army, and invaded the eastern parts of Scotland. He captured the town of Berwick, and cruelly put the inhabitants to the sword : a fierce contest between the Scottish and English armies soon ensued, when the former was utterly vanquished, and its principal leaders sought refuge in the castle of Dunbar. The castle, however, was immediately obliged to surrender at discretion, and, according to common report, the Earl of Menteth was put to death by Edward, in the seventy-sixth year of his age.

This Earl of Menteth had two sons. His eldest son, Alexander, Earl of Menteth, succeeded his father. Alexander was married and had three sons, 1st, Alan, who succeeded and died without issue,—2d, Murdac, who succeeded and died without issue,—3d, John, who carried on the male line of the family. Alexander Earl of Menteth, died about 1306. Sir John Menteth is first designed “*frater Comitis de Menteth*,” and afterwards, “*custos comitatus de Menteth*.” Sir John has been accused of delivering Sir William Wallace into the hands of the English, a fact which, like many others in ancient Scottish history, yet remains to be proved, and which his conduct, subsequently to the death of Wallace, tends to invalidate ; for although he held the government of Dunbarton Castle, under Edward, he strenuously adhered to the interests of Robert Bruce, and was, in 1306, and at other periods, employed by him in various public missions. Lord Hailes, an acute and intelligent historian, seems to think it probable that Wallace, after being taken, was confined in Dunbarton Castle, and thence delivered up to the English. Sir John was one of those who subscribed the celebrated letter to the Pope in 1320, asserting the independence of Scotland. He assisted at the coronation of Robert the First, and obtained from that king certain lands for providing a galley of twenty-six oars. Sir John had three sons, 1st, Sir Walter,—2d, Sir John, and, 3d, Alexander. Sir John Menteth died before 1333, and was succeeded by his eldest son Sir Walter, who had four sons, 1st, Sir Alexander,

who succeeded him, and died without issue,—2nd, William, who died without succession,—3d, John, who carried on the line of the family ; he had one son named William, who succeeded him about the year 1426. Sir William had two sons, 1st, Robert, who died without issue,—2nd, Alexander, whose descendants carried on the line of the family. Sir Alexander Menteth died early in the reign of Queen Mary, his second son James, carried on the line of the family, and left one son. James Menteith of Auldcaithie* married Magdalene, daughter of Sir Thomas Dalyell, Bart., of Binns, and assumed the name of Dalyell.

Dalyell, as a patronymic, is of considerable antiquity in Scotland. The family of Binns is one of the oldest cadets. Tradition carries it to a remote period ; for it is said that the favourite of one of the ancient kings having been taken by his enemies and hanged in sight of the camp, the king offered a great reward to whoever should cut the body down. No one, however, would undertake the perilous enterprize, until a valorous gentleman in his retinue at length stepped forward, exclaiming *Dalyell* ! which, in the language of the times, is said to have signified *I dare*. He accordingly left the camp, and regardless of danger, succeeded in restoring the body of the favourite. Nor did his courage pass unrewarded ; for the king bestowed lands upon him and his posterity, and assigned for their war armorial the body of a *hanged man*, with the motto, *I dare* ; which is actually the arms of all bearing the name of Dalyell at this day. Hence it is not improbable that there was some foundation for the story, the authentic record of which has been lost in the lapse of time. But however this may be, we know that there were formerly several eminent persons of the name in Scotland ; and the chronicles of old exultingly relate the prowess of Sir William Dalyell, who lost an eye at the battle of Otterburn, in 1388.

We shall pass over the lineal descendants of this family until 1571, when Thomas Dalyell was born, who died in 1642, and was succeeded by his son Thomas Dalyell. The latter early entered the military service, and, during the reign of Charles the First, commanded the town and garri-

* Sir Thomas Dalyell, *first* Baronet of Binns, had a son Thomas, and two daughters, named Magdalene and Janet. Sir Thomas, *second* Baronet of Binns, died unmarried, and was succeeded by his eldest sister Magdalene, who married James Menteith of Auldcaithie. Magdalene's son, Sir James, succeeded his uncle Sir Thomas, the second Baronet of Binns. Sir James, third Baronet of Binns, was succeeded by his eldest son, Sir Robert, fourth Baronet.

son of Carrickfergus, where he was taken prisoner by the rebels. After the death of Charles, he continued to adhere to the fortunes of his son, by whom he was appointed a major-general in 1651, and had a command in that capacity at the battle of Worcester. There he was taken prisoner, and committed to the Tower, his estates forfeited, and himself excepted from the general act of indemnity. However he made his escape, and seems to have gone abroad, whence he returned, and landed with some royalists in the north of Scotland, in March 1654. Supported by a small party, he took possession of the Castle of Skelbo, and assisted in the exertions then made for the restoration of Charles, who soon afterwards transmitted the following testimony of his approbation :—

“TOM DALYELL,

“Though I need say nothing to you by this honest bearer, Captain Mewes, who can well tell you all I would have said, yett I am willing to give it you, under my owne hand, that I am very much pleased to heare how constant you are in your affection to me, and in your endeavours to advance my service. We have all a harde worke to do : yett I doubt not God will carry us through it : and you can never doubt that I will forgett the good part you have acted ; which, trust me, shall be rewarded, whenever it shall be in the power of

Your affectionat frind,

CHARLES R.”

“*Colen, 30th Dec. 1654.*”

The king certainly did not forget his promise, for many marks of his favour were afterwards conferred on General Dalyell. When the affairs of Charles became desperate in Scotland, the General, provided with several strong recommendations from that prince for eminent courage and fidelity, offered his services to the Czar of Russia, Alexis Michaelwitch. By him he was quickly promoted to the rank of a general, and displayed much bravery in his wars with the Turks and Tartars. After active employment for several years, General Dalyell requested permission to return to Scotland, whereupon the Czar ordered the following testimony of his services, still in possession of his descendants, to pass under the Great Seal of Russia. Part of it is conceived in these terms : “That he formerly came hither to serve our great Czarian Majesty ; whilst he was with us, he stood against our enemies, and fought valiantly,—the military men that

were under his command he regulated and disciplined, and himself led them to battle ; and he did and performed everything faithfully as becoming a noble commander ; and for his trusty services we were pleased to order the said Lieutenant-General to be a General,—and now, having petitioned us to give him leave to return to his own country, we, the Great Sovereign and Czarian Majesty, were pleased to order that the said noble General, who is worthy of all honour, Thomas, the son of Thomas Dalzell, should have leave to go into his own country ; and by this patent of our Czarian Majesty we do testify of him, that he is a man of virtue and honour, and of great experience in military affairs ; and in case he should be willing again to serve our Czarian Majesty, he is to let us know of it before hand, and he shall come into the dominions of our Czarian Majesty with our safe passports, &c. Given at our Court, in the Metropolitan City of Muscōw, in the year from the creation of the world 7773, January 6."

General Dalzell accordingly returned to Scotland, where he was immediately appointed Commander-in-Chief of the Forces, and a Privy Counsellor in 1666 ; and was afterwards elected Member of Parliament for the county of Linlithgow. He quelled an insurrection in the west, and defeated the rebels at Pentland Hills. On a stone at Rullion Green, the scene of the action between General Dalzell and the Covenanters, is this inscription,—“ Here, and near to this place lyes the Reverend Mr John Crookshanks, and Mr Andrew M'Cormock, Ministers of the Gospel, and about fifty other true Covenanted Presbyterians, who were killed in this place in their own innocent self-defence, and defence of the covenanted work of reformation, by Thomas Dalzell of Binns, upon the 28th of November 1666. Rev. 12, 11. Erected September 28, 1738.”—

“ A cloud of witnesses lyes here,
Who for Christ's interests did appear
For to restore true liberty,
Overturned then by tyranny.
And by proud prelates who did rage,
Against the Lord's own heritage ;
They sacrificed were for the laws,
Of Christ their king, his noble cause ;
There hero's fought with great renown,
By falling, got the martyrs' crown.”

In 1666, he raised a regiment of foot, but we are ignorant where it stands in the military lists. Some years subsequently, however, he raised a regiment which has acquired considerable celebrity, the Scots Greys. It was formerly the custom for the younger sons of reputable families to serve in that regiment as volunteers, whence an opinion prevails that at one time the whole regiment consisted of gentlemen only. The letters of service for raising the Greys are dated the 25th of November 1681.

In 1679 General Dalyell, on account of a misunderstanding with the Duke of Monmouth, resigned all his employments, but was immediately restored to them : he received a commendation and approval, under the Great Seal, of his conduct in Scotland ; and a new and enlarged commission to be Commander-in-Chief. On the accession of James the Seventh, as a historian of that period observes, having procured himself a lasting name in the wars, he fixed his old age at Binns (his paternal inheritance), adorned by his excellence with avenues, large parks, and fine gardens, and pleased himself with the culture of curious flowers and plants. He died in the year 1685, leaving a son, Thomas Dalyell, of Binns. Immediately after his father's death he was created a Baronet of Nova Scotia, by a patent, conferring that dignity on himself and his heirs of entail succeeding to the estate of Binns. The patent sets forth with a recapitulation of the "innumerable, faithful, and eminent services of General Dalyell to Charles I. and II. ; and notwithstanding all losses and injuries sustained, that his fidelity remained unshaken : and further, considering that Captain Thomas Dalyell, his eldest son, has on all occasions testified the like alacrity in promoting our service," &c. Sir Thomas was succeeded by his son, Sir Thomas, the second Baronet of Binns, who died unmarried, and was succeeded by his nephew, Sir James, the third Baronet of Binns, who was succeeded by his eldest son, Sir Robert Dalyell, the fourth Baronet of Binns. Sir Robert served in the army during his earlier years, on the continent of Europe. He married in 1773, Elizabeth, eldest daughter of Nicol Graham, Esq. of Gartmore and Lady Margaret Cunningham, eldest daughter of William, twelfth Earl of Glencairn, by whom he had eleven children. Sir Robert Dalyell was succeeded by his eldest son, Sir James Dalyell, fifth Baronet of Binns, who likewise served in the army during his earlier years, and dying unmarried, was

succeeded by his brother, Sir John Graham Dalyell, Knight and Baronet, sixth Baronet of Binns, and the subject of the present memoir.

SIR JOHN GRAHAM DALYELL was born at Binns in August 1775. He was the second son. His father dying when the family were young, their education and bringing up devolved upon Lady Dalyell, who discharged her duty in the most exemplary manner.

Unfortunately Sir John, when an infant, had been allowed, by a careless nurse, to fall from a table upon a stone floor, by which one of his limbs was so much injured that he became lame for life. Perhaps it was owing to this physical deficiency that the mind of the youth was early led to seek amusement in mental recreation. Certain it is, at all events, that from his boyhood upwards he studied arduously—the dawn of morning seldom finding him in bed.

His early education was conducted by a private tutor, who resided in the family. Being delicate, he was sent to Moffat, when about ten or twelve years of age, for the benefit of the well. A little sister, nearly his own age, accompanied him as a companion, and died there. Her death was a sad blow. Upon his return he attended the classes, first at St Andrews, and secondly, at the University of Edinburgh.

He had early imbibed a taste for music, and his first instructor on the violin, while at St Andrews, is understood to have been a blind fiddler belonging to the place. During the vacations his time was frequently passed at Binns, where the progress made at the classes was greatly improved by extensive reading and research. Towards the end of last century, it became fashionable for gentlemen, by way of in-door exercise, to practise some of the mechanical arts. Being an excellent mathematician, having gained the medal in the class of mechanics, Sir John showed great aptitude in this department. His first attempt at lathe-turning was made upon a loom called a *spangie*,* in a hay-loft at Binns; and he has left a number of exquisite specimens of his ultimate perfection. Amongst others, a miniature brass cannon mounted—a truly splendid piece of workmanship,—and several small ivory vases turned into every conceiv-

* This was a very simple form of the turning-lathe.

able variety of curve with the utmost delicacy and accuracy. These were all executed upon mathematical principles—after a method of his own contrivance—never before nor since attempted.*

It is probable that his taste for natural history was acquired at Binns. That he had given early attention to this subject is evident from various circumstances, and confirmed by the following note, found among his papers, in his own hand-writing. It is curious, as recording the first of his observations.

“Journal in Natural History.

“1794,

“April 25.—Being the first of observation. I found in a standing water some particular insects, to be immediately described. Also put two aquatic snails in the vessel marked: also found a muskito [mosquito] escaping the form of an aquatic worm, but died in the carriage home; a caterpillar changing its skin on a holly tree. Saw an humble bee and several small moths; found one of Reaumur's *Teignes aquatiques*, the covering of small vegetable particles joined together.

“—— 26.—Saw the common red and white butterflies.”

In the second volume of “The Powers of the Creator,” the “aquatic worm” is delineated, with the fly produced, in Plate IV. figs. 21 and 22. The worm, however, ought to have been bright *scarlet*, in place of *black*. A collection of moths, butterflies, lady-birds, &c., gathered *sixty years ago*, is still in Miss Dalzell's possession. Sir John had also a great taste for mineralogy, and frequently discovered specimens of agate and jasper, which he got cut into seals and brooches.

While at the College of Edinburgh, Sir John qualified himself for the Scottish bar, of which he became a member in 1796. In 1797 he was a Fellow of the Society of Antiquaries of Scotland, and was chosen *first* Vice-President.

Next year he published his “Fragments of Scottish History. Edinburgh: Printed for Archibald Constable, at the Cross, 1798.” He had then attained his twenty-third year. The Fragments consisted of “The

* It may perhaps be added, in illustration of Sir John's mechanical ingenuity, that he made, when thrift and occupation were fashionable among the ladies, three beautiful spinning-wheels, splendidly mounted with ivory. Also several sets of chess-men. The smallest of his productions were two boxes, with lids, not larger than a very small pea.

Diarey of Robert Birrel, burges of Edinburghe." "The late Expedition in Scotlande, made by the Kynges Hyhnys armye, vnder the conduit of the Ryght Honorable the Erle of Hertforde, the yere of oure Lord God 1544;" and "The Expedition into Scotlande, of the most woorthely fortunate Prince, Edward, Duke of Soomerset, vncle unto our most noble Souereign Lord ye Kinges Maiestie, Edvvard the VI.," &c. By W. Patten, Londoner. These were introduced by a "Preface," and an Essay, entitled "Desultory Reflections on the State of Ancient Scotland." The "Annals of Scotland," and other works on our history, laws, and antiquities, by Lord Hailes, which had previously appeared, had induced a taste for such inquiries. The prefatory reflections show the extent of his reading, which was remarkable for his years. He gives expression occasionally to opinions which he might probably have modified in maturer years; but it is impossible to over-estimate the amount of classical and antiquarian research brought to bear upon the subject. That he was an accomplished linguist, and well acquainted with the Scottish cartularies (then in MS.) and ancient records available at the time, is amply evinced by the facts and arguments as well as the extracts adduced. In tracing the characteristics of barbaric life, he instances numerous coincidences between nations where no remains of a common origin exist, showing how intimately he had made himself acquainted with all the best works of discovery and travel.

Comparing the civilization of England and Scotland, he is very impartial; and although inclining to award England the advantage, seeing in the long wars and animosities to which Scotland was subjected, sufficient reason to account for the disparity, he gives one or two suitable illustrations on the point:—

"Cannon, it is said, were first used by the English, 1346; but we have good evidence they were used in Scotland, 1340. The oldest known English watch was made, it is said, in the sixteenth century. There exists a watch, which antiquarians allow, belonged to King Robert Bruce."

As to the much-boasted "*Roast Beef of Old England*," he says—"The truth is, that while the more elevated ranks enjoyed a sort of savage abundance, the commons had scarcely sufficiency to preserve life. . . . Amidst a thousand other delicacies, I find 'xii. porposes and seals' devoured at a feast, 1467, and the porpoise and seal are among the fishes enumerated

for the tables of Henry VIII.; the price covenanted, if the porpoise was not above one horse load, 13s 4d. The Earl and Countess of Northumberland, who perhaps lived in the first style of the times, have on their table, at seven o'clock, for breakfast, 'a loif of brede in trenchors, 2 manchetts, 1 quart of bere, a quart of wyne, 2 peecys of salt fysche, 6 bacound herryng, 4 white herryng, or a dysche of sproits.' On flesh days, 'half a chyne of mutton, or ells a chyne of beif boiled.' The annual consumption of linen, 70 ells. Only one tablecloth is allowed for 'the Knights boord in the great chambre, of 5 ells and 3 quarters long;' and only two washing towels for my Lord. The general service seems to have been in wooden platters; and, when the family removed, all their furniture travelled with them. These regulations were made in 1512. The maids of honour to Queen Catharine, were allowed 'a chet (wheaten) loaf, a manchet, a gallon of ale, and a chine of beef, for breakfast,' 1531. In times of scarcity, which do not appear uncommon, Holinshed says, the poorer classes were reduced to feed upon tares and acorns. This was in the reign of Elizabeth. Major ridicules the account Æneas Sylvius gives of the Scottish fuel, '*carbones nigros lapides vocans*.' Trifling as it may seem to possess coals or not, by the regulations of Henry VIII.'s household, they were permitted only in the King's, Queen's, and Lady Mary's chambers. When we turn our eyes homewards, we are presented with a wretched view of life. Sir Ralph Sadler, the English Ambassador, writes to the ministry in 1543, 'I hade leuer be among the Turkis; for in my L. of Angus house, wher he is, I cannot be, being the same (as I am crediblye informed) in suche ruyne, as he hethe there scant one chalmer for himselfe and my Ladye his wife; and lykewayis my L.L. of Cassillis and Glencairne, which dwell xx myllis a sonder, and almost xxx myllis from my L. of Anguse, be not so well housed as they can spare me any lodgyng; for undoubtedlye the l.l. houses in this miserable and beggerlye cuntrie, be not efter such sorte as in uther cuntries.'"

Sir John moderately adds:—"There may be some exaggeration here," and no doubt of it. National feeling ran high at the time. Cassillis Castle—the then residence of the Earl of Cassillis—still exists. It is a massive, high, castellated tower—with numerous apartments. He had, besides, the town-house in Maybole—only four miles distant—another large castellated building. The Earle of Glencairn had also more than one residence—such as Kilmaurs House—Kerrila Castle and Finlay House—all strong places—nor was Lord Angus worse provided.

Even at this period Sir John seems to have been an enthusiast, and well-versed in Scottish music:

"How unlike the production of savages, is the music of Scotland! No traits of barbarism are displayed in the Scottish song. Framed to touch the soul, its simple melody interests, while its pathos bears an unrivalled palm what were the most ancient instruments is

uncertain. Giraldus says they had three, *cithara, tympana, et chorus*. Several of the ornaments upon Melrose Abbey are figures of musicians. Upon the south or south-west wall is a figure playing upon an instrument, the lower part only of which remains: it seems to be a flute or hautbois, with six holes at most. Near this is a bagpipe blown with the mouth. It has but one drone: the whole is much defaced. There is another instrument, evidently the violin, with four strings: the sounding-holes are above the bridge: the hand is broken away, and the rest much defaced. Beside this is a female figure playing upon a six-stringed instrument, the strings disposed in pairs. I suppose this is what Mr Barrington has taken for the Welch Crwth. The form of the instrument is like the longitudinal section of a pear, and quite different from the drawing he gives of a crwth. The historian of the Irish Bards thinks he has mistaken a French viol for the crwth. If I were to hazard a conjecture, I should say it is a kind of lute. I can find it in none of the many authors upon music and musical instruments I have consulted. In *Mirsenne* and *Kircher* there is one bearing some resemblance. Upon the west side of the Abbey, there is a similar instrument, much larger, with the strings disposed singly. Both are very entire. Some author, I forget who, translates the word *chorus, crwth*. There are several other musical instruments, both within and without the Abbey; but I can pretend to describe no more. Some are so much effaced, that it is impossible to say what they have been. I have not observed any instruments without musicians, which are statues, or in basso or alto relievo. We are ignorant at what time they were placed there. The stones upon which they are carved form part of the wall. I cannot consider these instruments as deciding the custom of the country. Neither is it certain, as some authors think, that the architect of Melrose Abbey was a Frenchman. The language of the inscription, upon which this opinion is founded, is of a period long after the time of David I., if the whole structure was erected by that prince. Variety, with the most wonderful execution, seems to have been the object of the sculptor; which is proved by the amazing diversity of ornaments which still adorn this beautiful ruin. It is an error to think the bagpipe peculiar to Scotland. It was a Grecian and a Roman instrument, known by the name of *tibia utricularia*; at least there was one similar, which we sometimes meet on coins, vases, and other monuments of antiquity. It was not uncommon in the sister kingdom. Among the minstrels of Edward III. are five pipers. I doubt if the bagpiper is meant. Queen Elizabeth, who seems always to have had a tolerable band, annually gives her bagpiper Lxii: xiii: iiiij."

Such is an imperfect outline of Sir John's first contribution to the literature of his country.

His next publication was a translation of Spallanzani's "Tracts on the Nature of Animals and Vegetables," which was published by Constable in 1799. Spallanzani was an Italian Professor, and his experiments and discoveries were much appreciated at the time. They accorded well with

the translator's own predilection for the study of natural history, and by his means various interesting and astonishing facts were communicated to the British public.

In 1801 appeared, in two volumes 12mo,* "*Scottish Poems of the Sixteenth Century*." The principal of these was a reprint of that curious collection—"Ane Compendiövs Booke of Godly and Spiritvall Songs, collectit out of sundrie partes of the Scripture, with sundrie of other Ballates changed out of Prophaine Sanges, for avoyding of Sinne and Harlotrie, with augmentation of sundrie gude and Godly Ballates, not contained in the first edition." Thirty years previously Lord Hailes published some specimens of these songs, but Sir John gave the entire collection. In doing so, he had to draw from various sources, none of the existing copies being complete in themselves. The "*Booke*" is altogether a singular production, and no doubt the work of several hands.

"Long before this," (says Sir John,) "there was a Scottish version of the Psalms, and, at an early stage of the Reformation, this was renewed. A metrical catechism had likewise been compiled by an eminent reformer. They have been ascribed to one Wedderburn, of whom we know little. But there were three authors of that name, all endowed with a poetical talent. The eldest, it has been noticed, wrote tragedies and comedies. The second was first a Catholic, and then turned Protestant. Being persecuted as a heretic by the clergy, he fled to Germany, where he heard Luther and Melancthon. He translated many of Luther's principles into Scottish verse, and changed many obscene songs and rhymes into hymns. After the death of James V., he returned to Scotland. But, having again been accused of heresy, he fled into England, where he probably died about the year 1556. The third author was Vicar of Dundee; and, in learning, is said to have surpassed the other two. He went to Paris, and there associated with the Reformers; and, at Cardinal Beaton's death, returned to his native country. 'He turned the tunes and tenour of many profane ballads into Godlie songs and hymnes, which were called the *Psalms of Dundee*; whereby he stirred up the affections of many.' Whether this will be esteemed decisive evidence of the author or not, these poems were probably written merely to serve the present occasion; and the more literary reformers might have a share in them. Indeed, the very same expressions are frequently to be found in their other works. One observes he is in prison for religion."

Of the age of the originals Sir John hazards no opinion. Nor are

* There were large paper copies in 8vo, one volume. But the published sets were in two vols. 12mo.

they wholly Scottish. None of them are to be found in *The Houlate*, an allegorical work of the fifteenth century; nor in a manuscript collection of the latter end of the same century, preserved in the Advocates' Library; while there are only a few in the Bannatyne collection. From all which it would appear that they cannot be older than the close of the sixteenth century. Amongst the profane tunes spiritualised is one which, from the chorus, "La, lay, la," and the construction of the verse, may have been similar to "*Hey, tuttie taite.*" It is called "The Conception of Christ"—

"Lat vs reioyce and sing,
And praise that mighty King,
Whilk sent his son of a virgin bright.

La. Lay. La.

And on him take our vyle nature,
Our deidlie wounds to cure,
Mankind to hald in right.

La. Lay. La." &c.

As to "Quho is at my windo? who? who?" there can be no mistake. It is still popular. "My lufe murnis for me" seems to have been another familiar air. "Johne, cum kis me now," is well known; and "The wind blawis cauld, furious and bald" is apparently the first line of an old ditty. "Hay now the day dallis" is known to be another name for *Hay, tuttie taite.* "Till our gudeman, till our gudeman," is another well remembered air. So is "Hay trix, trim goe trix, under the greene wood tree." This is an English one, however. "Say weill, and do weill" seems to be part of an old rhyming axiom—

"Say weill is throughly a worthy gude thing;
Of say weill great vertew forth does spring;
Say weill from do weill differs in letter;
Say weill is gude, bot do weill is better."

"Ah, my Love, leife me not" is apparently another English air. To us, in modern times, such a collection may excite risibility—though the same principle is followed out in the composition of those songs for schools presently in use; and there can be little doubt that such ditties were of con-

siderable service in the Reformation struggle. Though some of them are ridiculous enough, yet there are not a few good psalms and hymns scattered throughout. From the frequent allusion in them to the Queen-Regent, the Pope, and the priesthood, it is evident that many of them were written in the heat of the first Reformation.

The other poems in this volume consist of "Ane Tragedie, in forme of ane Diallog betwix Honour, Gude Fame, and the Author heirof, in ane trance, 1570 :—" "The Lamentatioun of Lady Scotland, compylit be hirself, speiking in maner of ane Epistle," 1572 : "The Testament and Tragedie of umquhile King Henrie Stewart, of gude memorie," 1567 : "Ane Declaratioun of the Lordis Just Quarrel," 1567 : "Ballat," 1571 —(in reference to Edinburgh Castle and the Civil wars) : "The Sege of the Castle of Edinburgh, 1573 :—" "The Legend of the Bischop of St Androis Lyfe, callit Mr Patrick Adamsone, alias Cousteane :—" "The Battell of Balrinnis, foughtin betuixt Archibald Earll of Argyll, against Francis Earll of Erroll, and George Earll of Huntly, in anno 1594." These were introduced and explained by cursory remarks on the "Booke of Godly and Spiritvall Songs," in which Sir John gives a succinct account of the Reformation in Scotland ; by "some Incidents in the Life of James Earl of Murray, Regent of Scotland," which form an interesting outline of his career ; by "Biographical Sketches of Sir William Kirkaldy of Grange, Governor of Edinburgh Castle," and "a Faithful Narrative of the Great and Miraculous Victory, obtained by George Gordon, Earl of Huntly, and Francis Hay, Earl of Errol, Catholic Noblemen, over Archibald Campbell, Earl of Argyle, Lieutenant : at Strathaven, in the north of Scotland, 3 October 1594." This last, a translation.

The two previous works were dated from "Binns."—This, the third, and succeeding volumes, emanated from the family town-house, which Sir John found more convenient for his studies.

In 1803 we have another translation of the Abbé Spallanzani's "Tracts on the Natural History of Animals and Vegetables," in 2 vols. 8vo., published by William Creech. It contains a preface and an essay, entitled "Physiological Reflections on the Natural History of Animals and Vegetables," in which numerous instances of the phenomena of animal and vegetable life are recorded and explained.

In 1806 appeared "Journal of the Transactions in Scotland, during the contest between the adherents of Queen Mary, and those of her son, 1570, 1571, 1572, 1573. By Richard Bannatyne, secretary to John Knox." This bulky volume was printed by Ballantyne & Co., and published by A. Constable & Co. As explained by Sir John, in the preface, it is probable that both Calderwood and Spottiswoode, as well as the author of "King James the Sext," had seen Bannatyne's Journal; yet neither of them mention it. "Crawford (author of the Peerage), refers to the manuscript, *penes Robert Miln*; at whose death, in 1748, it most likely was conveyed to the Advocate's Library in Edinburgh." Sir John expresses his surprise "that this *Journal* should have been almost entirely overlooked by modern historians. Goodall, who writes in defence of Queen Mary, quotes it as authority, but does not mention where it was deposited, as the work is so adverse to the Queen, he possibly did not care about its being known." "Six or seven years ago," adds Sir John, "when engaged in an examination of all the manuscripts in the Advocate's Library, I found *Bannatyne's Journal* among some papers quite unconnected with the subject. It is entered in no catalogue of the Library, which further induces me to believe that Goodall, who was many years librarian there, was solicitous that it should remain in concealment." To Sir John's industry, and anxiety to illustrate the more obscure passages in Scottish history, we are thus indebted for *Bannatyne's Journal*. As secretary to John Knox, the author seems to have imbibed much of the bitter spirit of the Reformer. All opposed to his party are vilified and spoken of with the utmost contempt. The *Journal* is supplemented by several other manuscripts:—1. "Letters from Secretary Maitland and the Earl of Mortoun, 1572." 2. "An account of the Death of the Earl of Huntly, 1576." 3. "Confession of the Earl of Mortoun, 1581." 4. "Mutual aggressions by the contending factions, 1570." *

Although deeply engaged with his own inquiries, Sir John was at all times extremely ready to assist others. About this time we find him in correspondence with the celebrated George Chalmers, author of "Caledonia," &c., from whom the following letter has been preserved:—

* A complete copy of the MS. has turned up since Sir John's publication, and has been printed by the intervention of the Bannatyne Club.

“ OFFICE FOR TRADE, WHITEHALL,
20th Mar. 1807.

“ MY DEAR SIR,

“ I have received safely your music book, and your kind letter of the 28th ult.

“ I know not how to thank you for them; and still less for the honour of being chosen an Honorary Member of the Antiquary Society; as I learn from the Secretary. It will gratify me to receive, from so kind a friend, the other things which you are so kind as to say you will send I have not had time to study your music book; but I have made an engagement with a musician to go over it with me; and I will let you know what we think of it.

“ I shall be always happy in any occasion of showing you what a high value I set upon your friendship, as I am, with sincere esteem.

“ MY DEAR SIR,

“ Your faithful and obedient servt.

“ GEO. CHALMERS.”

We know not what music book it was that Chalmers refers to—possibly an ancient one, which Sir John had sent, for the purpose of aiding him in the compilation of his great work, the first volume of which appeared a year or two afterwards.

In 1809, Sir John called attention to those ecclesiastical remains of Scotland, so many of which have, of later years, been printed by the Bannatyne, Maitland, and Spalding Clubs. This he did in “a Tract chiefly relative to Monastic Antiquities, with some account of a recent search for the Remains of Scottish Kings interred in the Abbey of Dunfermline.” From the cartulary of the Abbey, which he describes, he drew considerable information as to its history, its laws, and privileges, and not a little illustrative of the state of the country generally—especially in reference to the servitude of the lower class of peasantry in ancient times. The *Tract* was well calculated to advance the object of the author, in awakening the literary world to the importance of such monastic antiquities. Some of the charters are written in the vernacular, and it is remarkable that the language was much the same in the thirteenth century, 1214, 1233—and the fifteenth, 1457—as it is at present. Latin, as stated in the cartulary, was always translated into *English*—thus showing that the English and Scottish were considered different languages. “The ancient

cocquet, or seal of the regality," says Sir John, "I fortunately recovered from Dunfermline, and have deposited it in the Advocates' Library, along with another of equal antiquity. Both are in good preservation, engraved on copper, and fully as old as the fourteenth century."

In 1811 Sir John, in a thin 8vo., published by Constable, gave "Some account of an Ancient Manuscript of Martial's Epigrams. Illustrated by an Engraving, and occasional anecdotes of the manners of the Romans." This was a valuable gift to the classical scholar. Martial's Epigrams are well known, and frequently quoted by the historical antiquary. Many of them, however, are obscure, as in the printed edition, and not a few of them wholly unintelligible. This arises partly from inaccuracies in transcription, and our superficial acquaintance with the manners and customs of the Romans. The manuscript in question, from a careful comparison with others, and the character of the penmanship, appears, in Sir John's opinion, to be as old as the middle of the ninth century, 850. It has been preserved in the Advocates' Library for upwards of a hundred years; but its history is unknown. "The only date it bears is 1632, there being inscribed on a blank leaf, *Jacobus Marchant hunc librum possidet ex dono Francisci Desmeuliere amici sui: Sedani 3 Decembris 1632.*" It does not seem to have been consulted by any of the editors of Martial, and from the various readings given by Sir John in illustration, we have no doubt of what he states, that "should a genuine edition of Martial's Epigrams be desired," it would, "in no inconsiderable degree facilitate the undertaking."

An interesting and popular work was published by Constable & Co., in 3 vols., in 1812, entitled "Shipwrecks and Disasters at Sea; or Historical Narratives of the most noted Calamities and Providential Deliverances, which have resulted from Maritime Enterprize: with a Sketch of various Expedients for Preserving the Lives of Mariners." No author's name was attached, but the compiler was Sir John. The narratives commence with the "Shipwreck of Pietro Quirini, near the coast of Norway" in 1431, and close with the "wreck of the Nautilus, Sloop of War, on a Rock in the Archipelago" in 1807. They were carefully selected from the best and most original authorities, and in many cases re-written, or put into a more condensed and intelligible form. Besides furnishing a most readable

work, Sir John had a beneficial object in view. Much of the loss and suffering at sea, occur from mismanagement, the want of knowledge, or of coolness on the part of the sufferers ; and it was to show how these, in numerous instances, might have been avoided or mitigated by proper conduct. This is improved and enforced by the "Sketch" at the close of the third volume, descriptive of the various inventions which had, up till 1812, been made public for the preservation of life in cases of shipwreck.

In 1814 Sir John published, through the medium of Constable & Co., "Annals of Scotland, from the Yeir 1514 to the Yeir 1591. By George Marioreybanks, burgess of Edinburghe." Marjoribanks died on the 20th of November, 1591, yet, strange to say, the annals bring events down till the 18th Feb. 1594. The narrative is brief, and affords little room for comment. One or two circumstances, however, are recorded, somewhat differently from the common belief. He states, for example, that the body of David Rizzio "was buried in the Kirkyaird of Holyrudhous," whereas the enemies of Mary assert that they were interred in the Chapel Royal, which adjoins the palace. Also, that "in the mounth of August, in anno 1568, the regent [Muray] caused burne Sir William Steuart, lyone king of armes, for sorcery, as wes alledgit." This is an incident seldom alluded to by historians, and there is no distinct account of the motives which led to it. The Knoxes and Bannatynes of the time had, of course, no desire to blacken the memory of the "good regent."

In 1814 Sir John also gave to the world his first treatise on natural history, in a thin 8vo., published by Constable & Co. It is entitled, "Observations on some interesting Phenomena in Animal Physiology, exhibited by several species of Planariæ. Illustrated by coloured Figures of living Animals." This volume treats of Planaria, *Flexilis*, *Nigra*, *Panniculata*, *Felina*, *Arethusa*, *Graminea*, *Velox*, *Edinensis*, and was the result of years of observation of the living animal. Though the author makes no pretension to any particular discovery, it is evident that nearly the whole of his experiments and observations were such as no previous naturalist had made with the same care and success. Planariæ are known as a genus of aquatic animals, somewhat like the leech or snail in external appearance, but differing from both. The two kinds experimented upon, as explained by Sir John, may be defined,—1. "Naked, flattish, in a state of abstinence,

provided with a proboscis protruding from the middle of the belly or under surface ; swimming supine." 2. "Body in a state of repletion, resembling a double cone ; mouth in the anterior extremity." The phenomena brought to light in regard to the food and habits of these animals are extremely curious. The species is propagated by eggs, but most of them have the singular faculty of reproduction by spontaneous division. The head, for example, separates from the trunk. In time a new head is formed, and the animal resumes its functions entire, while, from the separated head expands a new body. If any portion of the animal is cut off by accident, nature immediately sets about replacing it. If an incision is made forward or backward, beyond a particular line, it is possible to produce a second head, or a second tail, according to the position of the puncture. Sir John frequently tried the experiment.

Huber's celebrated "Observations on the Natural History of Bees"—a work entirely coinciding with the taste of our author—was translated, and in some manner condensed by him. The third edition, which we have before us, was published by W. & C. Tait, in 1821. This little 12mo had an extensive sale ; and Huber has long been considered a standard authority on Bees.

The following year Sir John had a communication from Baron Cuvier, whose letter we subjoin :—

" MONSIEUR,

" Permettez moi de vous remercier, non seulement du beau présent que vous m'avez fait en m'envoyant votre livre, mais encore du service que vous avez rendu à l'histoire naturelle en y remplissant une lacune demeurée vuide malgré les efforts d'hommes aussi habils que Müller et autres. C'en par des travaux de ce genre, par des observations assidues sur des espèces particuliers que l'on enrichire le plus surement cette belle science ; je serais bien heureux de pouvoir vous exprimer plus divertement l'estime que votre ouvrage me inspirée ; si vous venez jamais dans notre pays, j'espère que vous me fournirez l'occasion de vous en donner des preuves ; agreez je vous prie l'assurance de la haute consideration avec laquelle, je suis,

" MONSIEUR,

" Votre très humble et

" Très obeissant serviteur,

" B^A. CUVIER."

" *Paris, le 28. Juin, 1822.*"

In 1825 there appeared, in 2 vols. 8vo (London, Longman & Co.), a truly philosophical work, entitled "Historical Illustration of the Origin and Progress of the Passions, and their influence on the conduct of Mankind, with some subordinate Sketches of Human Nature and Human Life."

"Remarks on the Antiquities Illustrative of the Cartularies of the Episcopal See of Aberdeen"—another of Sir John's tracts in aid of historical inquiry—were published by W. and C. Tait, 1820. In this thin brochure he gives an outline of the history and constitution, tithes, historical incidents, legal antiquities, &c. Under the latter head he brings forward several valuable illustrations, especially in reference to civil affairs.

In 1826 Sir John printed a few copies of "A Brief Analysis of the Ancient Records of the Bishopric of Moray"—[*Murray*, as he afterwards corrected himself]. The analysis abounds in facts demonstrative of the necessity of a thorough investigation of such documents, if we ever expect to obtain a proper glimpse of our early history. That a code of laws existed in Scotland long prior to the time of Edward I., is evident from repeated references to them: so that whether *Regiam Majestatem* be authentic or not, there can be no doubt that justice was anciently regulated, both in the King's and the ecclesiastical courts, upon principles which have come down to our own times. Trial by jury, in civil as well as criminal cases, was common. The courts were frequently held in the open air. In 1380, "the Bishop had been cited by John Gray, lay mair of Badenach, to appear before Alexander Stewart, where went to keep his court of regality, and to show by what writings he held his lands. Advancing towards the court, which was kept at the 'Standand Stanes of the Rathe of Kingucy,' but remaining without its precincts, the Bishop refuses to acknowledge Alexander Lord of Badenach as superior of the lands in that territory belonging to the See." The standing stanes of Orkney, where justice was administered, are well known to antiquaries. The same practice appears to have prevailed in Murray, which would seem to point to the Scandinavian origin of the people. Access to such records of antiquity is invaluable to the student of Scottish history.

In 1828 appeared the last of Sir John's illustrations of the cartula-

ries deposited in the Advocate's Library. He had contemplated completing the entire series, but circumstances prevented the fulfilment of his intention. The work before us is entitled "A Brief Analysis of the Cartularies of the Abbey of Cambuskenneth—Chapel Royal of Stirling—Preceptory of St Anthony at Leith." Little of historical value is elucidated from these records, yet they are not without interest. They confirm the existence of an early and settled system of Scottish jurisprudence. Mentioning a case of arbitration before six laymen, decided in the Church of Perth in 1390, Sir John says "they pronounced an award as precise and formal as could be dictated at the present day. In another trial about the same time, the prisoner was ordained to do penance. From the nature of his sentence the ordinary dress of the peasantry at the time is plainly indicated. It consisted of a hood, or cloak with a hood, a hat, hose, shoes, and belt, with a knife. The nether garment is not mentioned. Although in a Highland district, the people do not seem to have worn what is now considered the Highland dress."

The industry of Sir John was unceasing; for in 1835, he favoured the public with a work with which his name will be perpetually associated. We allude to his treatise on "The Darker Superstitions of Scotland," published at Glasgow, in a thick 8vo., by Richard Griffin & Co. The labour bestowed upon it must have been immense. The illustrative facts are drawn from all authentic sources in this country, contrasted with similar superstitions in foreign countries in ancient and modern times.

About this time (1835) Sir John, who was a member of the "Association for Promoting the Arts in Scotland," and being himself, as formerly stated, an artist of great skill, exhibited to the society a number of articles of his own manufacture. From a lengthy article on the subject, in *Chambers' Journal*, we quote the following passages:—

"The amateur artist whose work we are about to describe, is Mr Graham Dalzell of Edinburgh, distinguished by his numerous antiquarian publications, and his patient inquiries into the habits of the zoophytical tribes, of which we lately presented some notices to our readers. This gentleman has for many years prosecuted turning as an amusement, and, by the exercise of much natural ingenuity, and an expenditure of time which perhaps no professional artist could have afforded, he has produced some kinds of work, not only of surprising beauty, but of such peculiarities of shape and ornament, as would seem to defy the art by which

they have been fashioned. The two principal specimens exhibited by Mr Dalzell were a hollow brazen and an ivory vase, of a circular form, and several inches in height, each provided with a cover. The brazen vase was formed from a coarse cast giving the general outline, and the ivory one from a solid piece of tusk. Instead of the parallel lines around the object which are usually produced by turning, these vases present a multitude of curves, angles, facets, and other figures, which, in the brass specimen, reflect the light in a beautiful manner; while the ivory one not only displays similar various carving, but is relieved by a great deal of open work, which, at a little distance, gives the whole the airy appearance of a piece of lace. Along with the specimens, Mr Dalzell exhibited some of his tools, and explained that the work is produced by combinations of the *rose engine*, *eccentric chuck*, and *drilling apparatus*, the tools being brought to bear upon some of the objects in much the same manner as those of the seal-engraver. He also showed that, instead of the ordinary application of turning to small and trifling articles, it was adapted for work of considerable magnitude, though, before attempting anything of the kind, the artist would require to undergo a long probation in plain turning, so as to become acquainted with the nature of the materials, the mode of working them into shape, and of bringing wood, ivory, and metal, to the highest finish. . . . The machine and its complicated apparatus, whereon the work submitted to the society had been executed, was made expressly for the owner by an excellent artist, Mr Andrew Paterson, also our fellow-citizen, at the cost of about two hundred pounds."

In 1836 we find Sir John corresponding with another devotee of natural history, Dr Bevan, in reference chiefly to a work about to be published by that gentleman. In reference to *Huber*, whose Treatise on Bees he had translated some time previously, he says :—

"*Apropos of Huber.* I am indeed the translator of his work, of which I endeavoured to give the sense in as far as possible, to comprize it in the fewest words—accounting brevity one intrinsic quality of literature, of which you have yourself afforded a good example.

"As to the precise extent of this celebrated naturalist's misfortune, I am induced now to conclude that the privation of sight was absolute. I have a brief manuscript memoir regarding him, written in French by one of his nearest relatives, purposely for my information. Though neither copious nor explicit, I can collect that, in his youth, he was devoted to mathematical pursuits, and in his endeavours to gain a certain prize, when at the age of nineteen, he laboured incessantly, not only during the day, but sacrificed his nocturnal repose—even continuing his studies by moonshine, when deprived of light by his father to repress such exertions. Over heated and exhausted by fatigue, he had to pass a snowy plain to reach his preceptor, when his sight was impaired by the dazzling lightness. He had not abandoned such pursuits even late in life, when my relation saw him, for "his wife was wont to embroider the plates of Legendre and other celebrated mathematicians in *relief* on cards for his use." "It is said also that he constantly refused the urgent solicitation of *M. Manneir*,

a celebrated French oculist, to be allowed to make an artificial pupil for him, saying he considered his blindness a guarantee against other privations."

In 1841, Sir John, by the death of his elder brother, Sir James Dalryell, succeeded to the family title as sixth Baronet of Binns. He had previously been honoured by her Majesty, in 1836, who in consideration of his eminent merit had conferred upon him the dignity of knighthood by letters patent.

In 1847 appeared "Rare and Remarkable Animals of Scotland, represented from living subjects: with Practical Observations on their nature. London: John Van Voorst, Paternoster Row." 2 vols. 4to. This expensive and beautifully got up work, contains no less than one hundred and nine coloured plates. The rare animals described were obtained chiefly from the estuary of the Forth, and belong to the zoophyte division of natural history, the least satisfactorily explained of any. Sir John, at the same time, is not quite satisfied that all of the species comprehended under this generic title are properly so. The treatise proceeds from actual observation, extending over a protracted period. One of the engravings represents an *Actinia mesambryanthemum* which had survived for twenty years in his possession, and produced 334 young. The zoophytes branch into innumerable resemblances of plants, trees and flowers,—and some of them are peculiarly rich in colour. In a *Compendium*, at the close of the second volume, the author takes a retrospective view of the facts which have been adduced from observation, and draws certain "abbreviated general conclusions, explanatory of their nature."

This work was hailed with much enthusiasm by the scientific world. Many of its details were either wholly new, or calculated to throw light upon what had been guessed at by previous inquirers, while the errors of others were satisfactorily exposed. The hydraform zoophytes and the Medusæ were supposed to constitute two distinct classes in the Animal Kingdom; but the observations of Sir John proved that they were in reality only different phases in the life of the *same individuals*. The relationship thus demonstrated between polypes and jellyfish had an interest beyond the mere fact, bearing as it did on other groups, and totally upsetting the theory of Professor Steinstrup of Copenhagen, as to the

"alteration of generations"—that is, that *like* does not produce *like*; but that the resemblance returns in the second generation. Sir John's volumes were noticed in the most flattering manner by such of the press as had access to them. *The British and Foreign Medico-Chirurgical Review* in particular had a long article entitled "Dalyell, Sars, Dujardin, and Van Beneden on the Development and Metamorphoses of Zoophytes." Speaking of an intended series on the subject, the Reviewer says:—

"It has happened by a fortunate coincidence, that the long-expected work of Sir John G. Dalyell has been published, just as we were beginning to carry this purpose into effect; and we most gladly avail ourselves of the opportunity of expressing the high gratification which an examination of its contents has afforded us, and our strong sense of the value of the researches in which the accomplished author has so long been engaged. We can only regret, for his own sake, and for the credit of British science, that some of his results were not earlier made known; since in the publication of his most remarkable discovery—that of the development, from a single polypoid animal, of a pile of young medusæ—he has been anticipated by continental naturalists. Sir John Dalyell, however, belongs to a race of naturalists (at present, we are sorry to say, too rare) who pursue the study for its own sake, and not for the honours or rewards to which it may lead; who are consequently not ambitious of exciting attention by new and strange announcements of imperfectly observed facts, or ill-digested hypotheses; who consider that, the more extraordinary a phenomenon appears, the more they are bound to verify it by careful and long-continued examination; and who studiously avoid mingling their observations and deductions, but record exactly what they see, and leave it to others to estimate the value of their facts, and to build upon them such inferences as they may think proper. Since the days of Trembley and Lyonnet, we doubt whether there has been such an example of the patient and consistent devotion of a large portion of a life to one department of natural history, as has been presented by Sir John G. Dalyell."

The delay in the publication thus alluded to was occasioned by a dispute and consequent law-process between Sir John and his engraver, owing to which it was delayed for nearly five years. By this untoward circumstance, he was deprived of the full credit of having discovered the splendid *hydra*, which he "provisionally denominated *Medusa stella*," from his inability to discover it in the *Systema Naturæ*. While his labours were thus locked up, M. Sars, of Norway, produced his work, and obtained that eclat which, by right, ought to have been conceded to Sir John. Professor Fleming was quite aware of the progress he had made with his

observations, especially in regard to the *medusa*. So annoyed was he with the conduct of the engraver, and the delay and vexation to which he had been subjected, that it was with great difficulty Professor Fleming and his sister persuaded him to go on with the publication. The work of M. Sars came out in 1846, only one year earlier than that of Sir John.

The propagation of the *Hydra tuba* (originally the offspring of a medusa), by throwing off a series of rings or discs, after ceasing germination in the ordinary way, is a fact, observes the reviewer, "our knowledge of which is entirely due to the persevering researches of Sir J. G. Dalyell," and it "is of fundamental importance in our philosophical interpretation of this wonderful process." After several high compliments, the writer concludes his learned article thus :—

"And last, though not least, we are desirous of holding up Sir John G. Dalyell as an example to our readers of every class—as a fine example of a patient, laborious, discriminating, and unprejudiced observer; perseveringly carrying out his researches, not merely day after day, and month after month, but year after year, and, we might almost say, ten years after ten years, for the mere love of truth, without the remotest particle of that self-seeking disposition, which, in these days, tempts almost every young investigator to rush into publicity with the crude results of his inquiries, rather shunning notoriety than courting it, and modestly expressing simply the facts which he has himself witnessed, without throwing doubt or discredit upon the statements of others. We need not say that we shall anxiously look for a continuation of the present publication; and that we trust, alike for the sake of science and for Sir J. G. Dalyell's own reputation, that it will not be long delayed."

Although no date is affixed to the following scrap of a letter from Professor James D. Dana, we have no doubt that it refers to this work :—"The scientific world will be greatly indebted to you for your laboured investigations on the lower aquatic animals, and I shall look forward with great interest to the publication of your work. The *Planula* is one of the most wonderful results of reproduction, and I long to see the mystery fully and satisfactorily explained." Sir John had been in the habit of corresponding with the writer.

From the numerous letters of compliment received by Sir John, after the publication of the "*Rare Animals of Scotland*," we beg to select the following :—

" SAINT BARTHOLOMEW'S HOSPITAL,
October 29, 1849.

" SIR,

I have asked my esteemed friend, Professor Goodsir, to give you a copy of some lectures I have lately delivered at our College of Surgeons. I beg your acceptance of them, not because I think they can afford you pleasure, but because I am anxious to acknowledge the great advantage which I derived, in preparing them, from your beautiful book on the *Rare Animals of Scotland*. I cannot sufficiently express to you my admiration of your researches, or the exceeding pleasure that I found in making myself (so far as I was able) acquainted with them. Permit me to add to all those you have already received, my thanks for your scientific labours, and my hope that you may yet, for very many years, be able and willing to instruct us.

" When Professor Goodsir told me of your love of antiquities, I begged him to offer you a copy of a pamphlet which I printed a few years ago, and which contains all that I could find, in our Hospital records, of the life and deeds of the great Harvey. Possibly, in this you may find some matters of interest to you; but if not, let it yet convey another assurance of my respect and gratitude. Allow me to be, Sir,

Your faithful Servant,

JAMES PAGET."

SIR JOHN GRAHAM DALYELL, Bart.

Mr Paget, in his lecture above alluded to, on "The processes of Repair and Reproduction after Injuries," referred to several diagrams which he had copied from Sir John's engravings, illustrative of the progress of the Hydra in its development of young medusæ, and of the *Tubularia indivisa*, thus generalizes on the importance of the discovery :—

" There are yet some topics which I will crave your indulgence, that I may suggest for your consideration, if only as an apology for a lecture in which I may seem to have been discussing doctrines that can hardly be applicable to our daily practice, and with illustrations drawn from objects in which, as surgeons, we may have but little interest. Let me, then, express my belief that, if ever we are to escape from the obscurities and uncertainties of our art, it must be through the study of those highest laws of our science, which are expressed in the simplest terms in the lives of the lowest order of creation. It was in the search after the mysteries—that is, after the unknown highest laws—of generation, that the first glance was gained of the largest truth in physiology—the truth of the development of ova through partition and multiplication of the embryo-cells. So may the study of the repair of injuries sustained by the lowest polypes lead us to the clearer knowledge of that law, in reliance upon which alone we dare to practise our profession—the law that lost perfection may be

recovered by the operation of the power by which it was once achieved. Already, in the facts that I have quoted from Sir John Graham Dalyell, we seem to have the foreshadowing of the facts through which the discovery may be made."

The "Musical Memoirs of Scotland, with Historical Annotations and numerous Illustrative Plates," a work for which Sir John had long been collecting material, issued from the press in 1849. A misunderstanding having occurred, however, between him and his publisher, Mr Thomas Stevenson, 87 Princes Street, Edinburgh, considerable delay in the printing ensued, and some deviation from the original plan.* He himself alludes to this in the preface: "I deem it necessary to explain, that while advancing with additional embellishments, a rude interruption compelled me not only to infringe my original plan, but to leave certain parts of it unfinished." He hoped, however, at an early period to "restore the projected integrity" of the "work in some acceptable form." The author did not live to fulfil his intention. He meant to have followed it up by another volume, entitled "Musical Practice," which is in manuscript, ready for the printer, and which we yet trust to see published. Sir John drew his facts from the most unquestionable sources—chiefly ancient records, and rarely hazards a conjecture, unless supported by the most cogent reasons. The bagpipe, as being the national instrument of Scotland, is treated of first, and numerous engravings of it given from the sculpture of Melrose Abbey, Roslyn Chapel, &c. It was a very simple contrivance originally—consisting of only a bag and chanter. It can be traced to ancient times, even on Roman sculpture, and on several religious houses in England, as well as on the Cathedral of Upsal, in Sweden. It was, and still is, common to the peasantry of Italy and Germany; and was one of the courtly instruments of France in the fifteenth century. In Ireland, it was, of course, common. From a print of "Irish Insurgents" in 1581, headed by a piper, the instrument, with a drone and chanter, is of unwieldy dimensions. But nowhere has the bagpipe been cultivated, as per-

* The law-plea which followed, was not concluded till after Sir John's death. The real point at issue in this absurd dispute was, whether an author should be allowed to retain his manuscript, and see his own work through the press.

taining to war, to the same extent, as in Scotland. Nowhere else has such complicated music as the pibroch been attempted. Sir John, however, does not find any record of its use in remote times. No mention is made of it by Ossian, nor yet, more recently, by Wyntoun ; and he is doubtful if any other instrument than the horn was used at Bannockburn. But ample notices of it occur from the fourteenth century downwards.

Instruction in music does not seem to have been practised in the Highlands by notation, though it may have been by language. This the author was the more inclined to believe from the fact of "John Campbell, a competitor in performance on the bagpipe," at Edinburgh, in 1818, having brought with him "a folio volume in manuscript, said to contain numerous compositions ; but the contents merely resembling a written narrative, in an unknown language, nor bearing any resemblance to Gaelic, they proved utterly unintelligible." A Murdoch Maclean from Glasgow, "offered to decypher the mysterious manuscript," but the proposal met with no encouragement at the time, and Sir John regrets that his subsequent endeavours to regain it proved fruitless. Campbell said there were other two volumes of the same kind belonging to his father. In tracing these he was alike unsuccessful. "If ever recovered," he says, "it is extremely desirable that they should be deposited as a curiosity in some public library." Captain Macleod of Gesto had the merit, it appears, of illustrating "so remarkable a fashion," and Sir John gives a specimen from the *Gathering of the Clans*—

Hodroho, hodroho, haninin hiechin,
Hodroho, hodroho, hodroho hachin."

From this specimen, we are convinced that it must have been one of the volumes mentioned, or a similar one, which we saw, about twelve years ago, in the possession of Captain Donald Campbell, then residing in Ayr—and if so, their recovery is not hopeless.

The bagpipe is perhaps regarded with more favour by the author, because of its being the origin of the organ—the progress in the construction of which he traces, with great precision, from the rudest attempts to the master-pieces of that magnificent instrument.

The harp furnishes an interesting chapter. It seems to have been a very simple instrument in early times. Several engravings are given from sculptured crosses in the north of Scotland; and one of the *Caledonian Harp* preserved in the family of Robertson of Lude since 1460, when it came into their possession by marriage. It is a superior instrument, having thirty-two strings. The *clairsha*—a species of harp—was also much in use at one time in Scotland.

The violin, as sculptured on Melrose Abbey, as well as in an illuminated MS. once belonging to Dunfermline Abbey—both of the fourteenth century—appears first with two strings. It is not till the sixteenth and seventeenth centuries that we find it in its present form. The viol, though differing in shape, was played in a similar manner, and violer and violin player are frequently used as synonymous in old documents. According to the song of “Logie o’ Buchan,” written by George Halket, who died in 1756, the viol was still in use in his time :

“O Logie o’ Buchan, O Logie the Laird,
They ha’e ta’en awa’ Jamie, that delved i’ the yard,
Wha play’d on the pipe and the *viol* sae sma’,
They ha’e ta’en awa’ Jamie, the flower o’ them a’.”

In the begining of last century Hew M’Quyre, Ayr, is styled “violer” in the parish records; but locally he was known to be a violin player.

Sir John finds that most of our reputed Highland airs—save those adapted for the bagpipe—which are peculiar—have been composed for the violin—so that they cannot be quite so ancient as some writers assert. When the harp was the prevailing instrument, considerable intercourse was kept up between the minstrels of the three countries. In the household accounts, both of the Scottish crown and nobility, numerous payments appear to English and Irish musicians—as, for example in 1502, “the Inglis harpar,” “the Irland clarschar.” The Highland harpers were styled *Earsch*, not Irish, as the two terms are sometimes confounded. From the intercourse thus maintained—especially between the Irish and Highland harpers—the national music of Ireland and Scotland became to some extent intermixed.

In the course of the treatise almost every known instrument is brought under review by Sir John, and from his known musical science and practice, his remarks are not less sound than original.

The first volume of Sir John's last and great work—"The Powers of the Creator displayed in the Creation ; or, observations on Life amidst the various forms of the humbler tribes of Animated Nature : with Practical Comments and Illustrations," was published by John Van Voorst, London, in 1851. The second volume, after the author's death, was brought out in 1853, under the superintendence of his sister and Professor Fleming, the latter of whom introduced it with a short preface. Part of this, the third volume, had also the benefit of his oversight ; but it is chiefly to Miss Dalyell that the public owe the completion of the work. A portion of the volume, however, is printed from the manuscript, as left by the author in an imperfect state.

"The Powers of the Creator," illustrated by two hundred excellent engravings, may be considered a continuation of the "Rare and Remarkable Animals of Scotland"—imbued, perhaps, with a higher tone of philosophy. It is impossible to study any particular department of the works of Nature, even the most humble and apparently insignificant, without having the mind exalted in contemplating the grand design of creation. Sir John soars into this region ; but it is with a staid wing, convinced of man's littleness, and the folly of attempting to penetrate the veil which bounds our finitude. The speculations of philosophers as to a great First Cause, and the development of the system of which the human race forms so distinguished a part, he treats with little consideration, and regards the theory of progressive creations as improbable. His object is less to inquire into the reason why, and by what means, the world was produced, than to trace in the wonderful organization and instincts of the lower animals the power and goodness of an all-ruling Providence. In the world of science, also, his aim is less to discover new races than to study more attentively the habits and qualities of those rarer species, whom naturalists have overlooked, or but imperfectly described. When it is understood that the observations instituted by Sir John extended over a period of fifty years, and that some of the aquatic specimens were in his possession

alive upwards of twenty-two, we may conceive the great care and minuteness with which they were made. The various changes to which many of the lower animals are subjected—in their transformation from one state of existence to another—have confounded the learned, who were led, in not a few instances, to consider them, under these different aspects, as different species of the same genus. It was to rectify this—in so far as the Scottish waters could be made available—that he laboured ; and, from accurate delineation and description, to render the rarer varieties of the lower world more familiar to the student—conceiving that the mere anatomical distinctions of the scientific were not so well calculated to promote a proper knowledge of animated nature as accurate delineations of the outward form. The subjects experimented upon exceeded *one hundred and sixty* in number, and are classed under *Echinodermata*, or rough skins, *Crustaceans*, *Parasites*, *Hydrachna*, *Hirudo*, *Vermes*, *Planaria*, *Nais*, *Lumbricus*, *Nereis*, &c.

A copy of the second volume of "The Powers of the Creator," as well as the first, having been forwarded by Miss Dalyell to Dr Carpenter, London, the gift was acknowledged by that gentleman in very complimentary terms. From his letter, dated 5th Oct. 1853, we beg to quote the following passage :—"It is with peculiar satisfaction that I have looked through his (Sir John's) observations on the 'Nautiline.' All that he has so cautiously surmised, has been since confirmed most satisfactorily. The 'Nautiline,' with its beautiful little shell, and pair of ciliated appendages, *is* the young of *Doris* ; and almost all the naked sea-slugs allied to it in general structure have similar larvæ. I wish all naturalists would record their *actual observations* as your brother did, and separate their deductions as he was accustomed to do ; so that we might distinguish *facts* and *hypotheses*, and be able to assign to each their due value."

Besides these separate works, a number of papers by Sir John appeared from time to time in the *Philosophical Journal*. The substance of the first, giving an account of the "*Hirudo muricata*, or Sea Leech, with a description of its ova and young," was noticed in the *Journal* for 1827. It had been thought, remarks the editor, that up to that year the ova and young of the Sea Leech had remained unknown, whereas a distinguished observer of this place (Sir John,) had bred the animals in jars

of sea-water in 1822, noting all the changes from the laying of the eggs till the evolution of the perfect animal. The drawings and remarks of the author, in MS., were before the editor.

Another article, on the "Propagation of Scottish Zoophytes" appeared in 1834. It was to this paper that Sir John refers in his "Rare and remarkable Animals of Scotland :—

"Let me here premise, that some years ago, long after the subject of this paragraph had come under my notice, I submitted a few general observations regarding it to the British Association for the Promotion of Science, during the sittings of that learned body at Edinburgh in 1834. As the study of natural history was advancing but languidly in Scotland, my principal aim was then, as on previous and subsequent occasions, to engage the attention of my countrymen with the interesting phenomena which they might readily discover among our national products. Therefore, selecting only the facts most easily attained, nor exacting painful and protracted study, I sedulously abstained from discussing various other important and still more interesting points, though sufficiently acquainted with them. I believe now that it would have been better had I done differently; for it would have prevented certain authors from betraying themselves into very erroneous conclusions of the import of my observations."

"Reference is here probably made, in part at least," says the Medico-Chirurgical "reviewer," to the very harsh comment of Steinstrup upon the observations communicated from time to time to the 'Edinburgh New Philosophical Journal' by Sir J. G. Dalyell; of which he says—'These observations are not only filled with matters of which Sir J. G. Dalyell has taken a false view, but also contain phenomena which he has misunderstood; and they have consequently been of no utility in science, until now that other fundamental researches have allowed of their being correctly explained. Now, it is perfectly apparent to us, that the Scottish observer must have been in possession of the real truth from a period much earlier than that at which it had been deduced from the researches of Sars and Siebold, who have hitherto enjoyed the full credit of first unveiling the remarkable phenomena we shall presently describe; although, with the characteristic caution of his countrymen, he hesitated to make his views fully known until he had most fully satisfied himself of their correctness, and consequently employed, in such descriptions as

he put forth from time to time, phraseology which by no means conveyed his whole meaning. And it is further evident to us, that his observations have been far more prolonged, and have attained on many points a far greater degree of exactitude and completeness, than those of either of the authors we have just named ; and we shall show that one point of fundamental importance has been clearly established by Sir J. G. Dalyell, although neither Sars nor Siebold was able to make it out ; and that he has thereby been led to a much more accurate conception of the whole process, than they or their followers have attained."

The reviewer then refers to the series of observations by which Sir John proved that the *Hydra tuba* springs from *Medusæ*, and that the *Medusæ* are themselves the progeny of the *Hydra*. The process by which the latter breaks up into discs, and becomes separated into independent animals, is minutely described by Sir John : and the reviewer considers the fact that, while the topmost disc loses its circle of tentacula, a new circle is developed upon the summit of the bulb that remains at the pile of discs, a discovery of great importance, and one which has escaped the notice of other observers. By this means, he says, "*the original polypoid body still remains*, and may return to its polype life and gemmiparous production, becoming the progenitor of a new colony of *hydræ*, every one of which may develop in its turn a pile of medusa-discs. Now, this fact, our knowledge of which is entirely due to the persevering researches of Sir J. G. Dalyell, is of fundamental importance in our philosophical interpretation of this wonderful process."

A third essay, entitled "Singular Mode of Propagation among the Lower Animals," also appeared in the *Philosophical Journal* in 1835. An essay "On the Regeneration of Lost Organs, discharging the Functions of the Head and Viscera, in the *Holothuria* and *Amphitrite*, two Marine Animals," was embodied in the Report of the British Association, 1840. Another, on "The Reproduction of the *Virgularia*," appeared in the *New Philosophical Journal*, volume 27 ; and a paper entitled "Examples of Exuviation, or change of the Integuments of Animals," was read at the meeting of the British Association, August 1850, and embodied in their annual Report, 1851.

Sir John was also a contributor to the "Encyclopædia Britannica," "Douglas' Peerage," and "Burke's Baronetage." From his extensive acquaintance with ancient documents, and matters of antiquity generally, he possessed many advantages as a genealogist, and was frequently applied to by friends and others to make out their family descent. In this way he was called upon to discover the chief of the Buchanans, an inquiry which had baffled all who attempted it. He was successful in tracing the honour to Dr [Buchanan] Hamilton of Leny.

From this narrative it will be seen, that Sir John was a proficient in various branches of literature and science. He was a thorough linguist, mathematician, mechanist, antiquary, genealogist, musician, historian, and zoologist. In this latter character, the *North British Review*, for November 1854 observes—"Indeed it (Torquay) may well claim the honour of being the original home of marine zoology and botany in England, as the Firth of Forth, under the auspices of Sir John G. Dalryell, has been in Scotland." Sir John was no copyist. All his labours were in unexplored fields, and his aim seems to have been not to multiply books, but to illustrate history, and advance science by the production of what was new or not generally known.

Being a member of the Faculty of Advocates, and for the better indulgence of his literary and scientific tastes, he found it necessary to reside permanently in Edinburgh, which he did with his mother, and four sisters, in the family town-house. One of the sisters having married, and the other two dying, the care of Sir John, who was always delicate, devolved upon his mother and youngest sister. On the death of Lady Dalryell, in 1825, the latter became his sole help and companion. The demise of his venerable parent greatly affected him, and in order to divert his mind, he and his sister proceeded on an excursion to the Island of Bute, where their time was chiefly spent in exploring the antiquities and natural history of the place. Here Sir John saw for the first time a living Conger, which had been caught in the harbour at Rothesay. On his return to Edinburgh he was seized with a violent fever, and continued very ill for some time.

As delicately alluded to by Sir John himself, and explained in Professor Fleming's preface to the second volume of the "Powers of the

Creator," his sister was an able assistant in all his zoological researches—both in procuring specimens, and facilitating his observations; and we may reiterate the statement of Professor Fleming that it is wholly owing to her respect for the memory of her talented brother, and a desire that the scientific world should reap the full benefit of his observations, that this his last work has been so satisfactorily brought to a close. She attended him in all his excursions, undertaken every summer, to the fishing stations at North Berwick, St Andrews, &c., for the purpose of picking up such rare animals as the fishermen might have fallen in with. Many specimens were obtained from Orkney, which were usually forwarded by parties on the spot.

These excursions were much enjoyed both by Sir John and his sister. To the student of nature nothing is more pleasing than to escape from the busy hum of men, and contemplate the varied and beautiful works of creation. No truly great mind can be insensible of the peculiar feeling so produced. Scenes of striking grandeur, or of calm repose, awaken corresponding thoughts, and are often the source of high emprise, or of calm and dignified philosophy. Upon one occasion, amongst many, the tourists spent a very happy day at a place called Canty Bay, eastward a short distance of North Berwick. The bank was literally covered with primroses in full bloom. The fragrance might extend a mile. About half-way down the bank they seated themselves upon a fallen tree, near to a rill which settled itself into a sort of pool or marsh. There Sir John found the beautiful zoophite *Vorticella* (Plate 21, "Rare and Remarkable Animals," Vol. I.) It resembled a bunch of the finest silk thread, almost imperceptible to the eye of any one save a zealous naturalist. Placed under a high magnifier, in the microscope, however, the beautiful bell flowers were displayed, all tacked together and suspended by the slender cord which bound them in such luxuriance. As he was stooping to take it, something rustled under the skirt of his coat, and upon looking, it proved to be a bird (yellow-hammer,) which had quitted its pretty little nest, containing four eggs. Curious enough, it returned after a few minutes, and slipped back to its charge, unconscious apparently of danger being near. The spot was certainly a solitary one, but the splendour of the

scenery could not easily be obliterated from the mind. The sun was vertical—there was not a breath of air—the sea was like a sheet of glass, without a ripple moving it. The Bass Rock rose in majestic splendour, seemingly almost close to the eye. The wild birds, screaming and screeching over the barren rock, literally darkened the air like a cloud. Nothing could be discerned beyond, except sometimes a ship slowly passing to or fro the blue expanse of ocean. All was silence—all was solitude, save a few fishermen's huts upon the brink of the sea, and the romantic ruin of Tantallon Castle, respecting which so many wonderful stories are related in that part of the country.

Though much engaged with his literary and scientific pursuits, together with his legal duties—for although the Parliament House proved too fatiguing for him, he had considerable business as a consulting lawyer—Sir John still found leisure to cultivate that social intercourse which rendered fashionable life in Edinburgh, during the early part of the present century, so agreeable. We mean the select private parties held at one another's houses. The visitors met about eight o'clock, and generally broke up between eleven and twelve. The time before supper was usually spent in playing quartets and quintets, and after, in singing catches and glees. The suppers were studiously plain, so as to suit the circumstances of all. Sir John was equally free in performing at charitable concerts, when called upon for that purpose by the parties interested. It may be mentioned that his violin—a genuine Straduarius—once belonged to Stabilini, well known as a leader of the Edinburgh concerts at the beginning of the century, and is now retained as an heir-loom in the family. It is rather a curious coincidence that Sir John should also have become possessed of Stabilini's violoncello. It was a gift to that performer by the Countess of James Earl of Hopeton. After his death, his widow was desirous of disposing of it, but none of the gentlemen being inclined to purchase it, they considered the best plan for her was to raffle it. Sir John held a ticket, but having a particular engagement on the day of raffle, a friend, who called in passing, undertook to throw for him. The gentleman threw first for himself, and secondly for Sir John, which latter throw proved the highest, and Sir John (then Mr Dalyell) was declared

the winner. He thus became the owner of both of Stabilini's famous instruments.

As already mentioned, Sir John became a member of the Society of Antiquaries in 1797, and it is needless to say, from his taste for antiquities, that he took much delight in the institution. He was the first Vice-President of the Association. He was also a member of "The Society of Arts for Scotland," of which he was one of the Vice-Presidents for Session 1836-37, and President for that of 1839-40. He, of course, early became a member of the "Royal Physical Society," and at one of its more recent meetings exhibited an aquatic specimen which he had preserved and described in his "Rare Animals of Scotland." The circumstance is thus referred to in a newspaper paragraph at the time :—

"The Royal Physical Society met at No. 6, York Place, on Wednesday evening, the 10th instant. A living *Actinia*, of gigantic size, was exhibited to the Society, through the kindness of Sir John Graham Dalyell, Bart. The specimen was accompanied by a few notes from Sir John, stating that it was the largest individual of any species he had yet met with, measuring nine inches in diameter when fully expanded.

"He remarked that the strength of this animal was very great; that, adhering firmly by its base to a solid substance, it would seize, retain, and absorb in its dilatable mouth any creature almost as large as itself; that even a human hand or foot might find some difficulty in freeing itself from its powerful grasp.

"Sir John stated as an illustration of the extreme longevity of these *Actiniae*, that he had now in his possession a specimen of another species which had survived in captivity nearly twenty-two years; during that time it had produced 300 young. The secretary was directed to return the thanks of the Society to the Hon. Baronet for his attention."

Deeply interested in every thing connected with the elucidation of natural history, Sir John was an associate of the "Palæontographical Society of London," and an honorary member of the "African Institute" of Paris.

Imbued with a high degree of public spirit, and somewhat national withal, Sir John was enrolled a member of the "Highland Society,"—(latterly named "The Highland and Agricultural Society of Scotland,") in 1807. He soon made himself of great use to this patriotic association. He all along took a warm interest in its business—particularly in reference

to Celtic literature, so long as the Society's attention was directed to its elucidation—and in the department of machinery. He was a director for many years, and chairman for a length of time of the committee of mechanics. He himself was a contributor to this department. In 1816, his services were acknowledged by a piece of plate, with the following inscription, surmounted by the Dalyell arms :—" Voted by the Highland Society of Scotland to John Graham Dalyell, Esq., advocate, for a self-regulating calender, invented by himself. MD.CCCXVI."

Amongst other beneficial reforms, he suggested the propriety of having printed programmes of the subjects to be discussed at the general meetings. Previously no one knew what was to be done. In consequence of this very obvious improvement, the transaction of business was greatly facilitated. At one time the fresh butter brought into Edinburgh was so bad as to be scarcely fit for use. Through Sir John's instrumentality the attention of the Society was drawn to the subject, and means adopted, by which the supply has ever since equalled, if not surpassed, in quality, that of any other city or district in Scotland.

For many years the Highland Society of London held a competition for bagpipe music annually, and afterwards triennially in Edinburgh. These competitions were conducted by a committee of the Highland Society of Scotland. Sir John was a member of that Committee ; and his enthusiasm and well-known knowledge of, and taste for music, made his services on the committee most valuable. In 1849, in a note to the "Musical Memoirs," he himself says—"From active participation in the management of this great national association, during the unusual period of forty years, I have had great opportunity of witnessing its progress. Now consisting of nearly 3000 members, it is the best adapted for diffusing the taste and practice of improvement throughout the country. But it is sometimes difficult to guide a multitude, or to obtain unanimity in plans of acknowledged utility. Among various expedients for public benefit it would be highly beneficial to commence with the very origin of every process, and conduct it to its final close."

Sir John was one of the original promoters of the Zoological Gardens in Edinburgh, and laboured hard to maintain it in an efficient state. He

was Preses of the Board of Directors in 1841. Before us is a portion of a circular, in that year, entitled "Remarks on the state of affairs of the Zoological Gardens, by Sir John Graham Dalyell, Bart., Preses." "Our greatest exertions," he remarks, "must now concentrate in endeavouring to repair our shattered finances." His plan embraced certain propositions, the principal of which were—the increase of income, payment of the creditors, and protection of the Directors from loss. Though successful for a time, we believe the Gardens were in a backward state, till recently that they have fallen into the hands of Mr Wood.

After a life spent in laborious study, and in the exercise of a truly patriotic and charitable activity, Sir John at length fell into infirm health. He had a learned and experienced medical adviser in Professor Lizars, who exhibited the utmost zeal for his patient, and frequently alleviated by his skill the severity of his sufferings. Notwithstanding every care, however, he sunk, in perfect consciousness, on the 7th of June 1851, attended by his afflicted friends and domestic servants, the latter of whom he did not fail to requite for their long and faithful services. He was interred beside his ancestry, in the family vault in the church of Abercorn, Linlithgowshire.*

The service rendered to literature and science by Sir John Graham Dalyell, Knight and Baronet, can hardly be measured by his publications, numerous and bulky though they are. They bear only a small proportion to the incessant study, research, and investigation which they involved before a single line could be written. His genius aimed steadily at the production of what might add to the knowledge or advantage of the world. Indeed it would be difficult to estimate the character of one so singularly laborious, and so disinterested in his views. Whatever the subject, it was entered upon enthusiastically, and pursued, if not entirely *con amore*, with the intention, at least, that the result might be beneficial. Sir John carried his notions of the useful so far as to discard and despise all works of fancy and fiction, however excellent. It would be difficult to name another of his age who has contributed so much towards the elucidation of natural

* The Binns tenantry and family seat is immediately over the vault.

history. The work to which this is appended is in itself a splendid monument of his industry. It contains above two hundred beautifully coloured engravings, and if the figures on each plate were to be reckoned, they would amount to several thousands, every one taken from healthy, living specimens, and delineated, under his own observation, by the first miniature painters. His observations were all original—not the work of a day or a year, but of perhaps forty or fifty years, before venturing to lay them before the public, least errors might have crept in. We should like to know which of his contemporaries has gathered such a mass of information? The present work may be considered an everlasting memorial of his great labours and unequalled observations, and most justly he may, in the words of one of his correspondents, be styled *the Prince of Observers*. He was, in short, a man of the age.

Intense must have been his earnestness in the work. The large outlay of money it involved, was little compared to the physical as well as mental labour expended in its prosecution. Some of his specimens, no doubt, survived in confinement for many years, affording ample leisure for observation, but most of them were transitory; and when we consider the anxiety and watching, night and day, to catch the precise moment when the expected phenomenon might occur, or the anticipation of some new development be realized, we may well wonder at the devotion to science which could tempt a man of independence and of delicate health, so to forego the ease and comfort which his circumstances were well able to afford. It was only at particular times, frequently at night, that the talent of the artist could be effectively employed, and even then the difficulty of correct delineation was often most irksome. All these obstacles encountered and overcome, however, we can easily fancy the delight with which the countenance of the inquirer would be lighted up when success rewarded his toil. How astonished he must frequently have been when, on returning, after some hours absence, he found the object of his solicitude perhaps divided into two, or metamorphosed into a new animal altogether. This must have been particularly the case when he first discovered the conversion of the *Hydra tuba* into *medusa* discs. In short, the present three volumes, as well as the previous two on the “Rare

Animals of Scotland," will be found replete with the most interesting revelations.

Although Sir John neither aspired to be the founder of a new system, nor even the discoverer of a new genus, his observations abundantly prove the errors of others in this respect. He regarded himself merely as one of the pioneers—one of the accumulators of facts—in aid of the great undertaking yet to be accomplished—the task of correcting and amplifying the existing *Systema Naturæ*. It seems to have been a special object with Sir John to impress the study of the living animal—with a view to its classification—rather than that of its anatomical formation; and he never fails to show the advantage of the one over the other. He proves, in short, the impossibility of anatomical classification of the lower animals—the characteristics of most of them being so entirely different in a living and a dead state. We have no doubt that this, his last and favourite work, will be hailed as enthusiastically as was his "Rare Animals of Scotland;" and we trust that every indulgence will be conceded on account of the circumstances under which the two concluding volumes have been put to press. So far back as January 1851, Sir John began to fear, from his declining health, the improbability of his being able to finish his elaborate work. About the middle of May of that year he requested Professor Fleming to see the second volume through the press, which the Professor kindly did, besides wading through a portion of the natural history of the present volume. But the completion of it was a very difficult task. Having been unfortunately cut off before the text was clearly written out, Sir John's note-books had to be resorted to, for there were ten or fifteen beautiful drawings found in his repositories, ready for the engraver. Many acknowledgments of gratitude are due to Professor Allman for his goodness in assisting to compare the plates with the text; also to Mr J. Davies, a very clever naturalist, recommended by the Professor. At the same time, wanting the accurate eye of the author himself, it is possible that there may be defects; but these, we believe, will be found chiefly of a clerical or typographical character, reflecting in no manner on the facts and observations recorded.

It may readily be conceived that, to accomplish so much for litera-

ture and science, and attend at the same time to business, both of a public and private nature, Sir John must have husbanded well his time. He usually breakfasted early, and, if nothing called him abroad, repaired to his study at ten o'clock. Here he continued industriously till two, when he regaled himself with a large cup of tea. He then either drove out, or made a call ; at four o'clock he repaired to his turning-lathe till dinner called him. At seven he again went to his study till nine. After that, he played on his fine violin a while, came to his friends, with whom he always lived, at ten ; drank his glass of ale, and retired to rest at eleven. He was very abstemious, never exceeding two glasses of wine at dinner. Such were his regular habits, interrupted only by business calls, or the demands of the various public institutions of which he was a member. We have said that he had considerable employment as a consulting lawyer ; and although a younger son, and not what the world might call wealthy, he made it a rule of his legal practice never to accept a fee from a relative, a widow, or an orphan. A memorial of this generous resolution, we have seen in a handsome piece of silver plate, presented to him by a widow lady, for whom he had done a good deal, with the following inscription :—
“To John Graham Dalyell, Esq., advocate, in testimony of her gratitude for repeated instances of disinterested friendship.”

Though naturally quick tempered, Sir John was not resentful. Notwithstanding numerous provocations, he never was known to commit to paper an ill-natured line in his life. He was grateful for a good action, warm-hearted, and much beloved by his nearest relatives—his advice being always first asked in every question of doubt. He deprecated gambling, disliked dancing, and could not endure debating. Though highly educated, and an excellent lawyer, he never seemed to know the way to argue. He liked to discuss particular points with calmness and moderation, being very quiet and gentle in his manners. He was favoured with a highly cultivated mind and sound understanding. There was scarcely any subject upon which he could not talk, and give information. He had, it may be said, every accomplishment which education could bestow. Antiquities, music, and natural history were the subjects which he chiefly wrote upon. Mathematics were a favourite study. As formerly men-

tioned, he invented various sorts of tools for lathe turning, and by means of his mathematical acquirements, was enabled to execute the most delicate and minute figures, more resembling lace-work than any thing else they could be compared to. In this recreation he took much delight in his latter days.

He had an innate appreciation of integrity, and love of truth. In general he spoke little, and appeared at all times engaged in thought, as if resolving, as he sat by the fire with pencil in hand, some philosophical experiment. He was himself very quick of apprehension—seeing a thing in a moment, and nothing disturbed his equanimity so much as stupid people. He had a grave, benign, handsome countenance. His black expressive eyes spoke the strong emotions of an animated mind, and his dark hair and beautifully arched eyebrows indicated the minute observer. His manner was unpretending, yet dignified—the very wave of his hand betraying in it something gentlemanly. His last words of adieu to all were—“God love you.”

We might have extended this memoir of the author of “The Powers of the Creator” to much greater length, but our object was, without swelling it beyond its due proportion of the volume, to give the reader a concise yet pretty full and accurate conception of his life and writings. If we have succeeded in this, without prolixity, our aim has been attained.

CHAPTER I.

SEPIA—THE CUTTLE FISH.

No animal has excited greater curiosity, whether in ancient or in modern times, than the Cuttle Fish. Its singular external aspect, and its peculiar attitude, together with its uncommon anatomical structure, have alike drawn the attention of the transient observer, incapable of duly appreciating the subject before him, and of the profound philosopher, who knows to venerate the works of the Divine Architect of Nature.

An animal which always advances with its head downwards, as if reversing the ordinary rules directing living instincts,—which contains but a single bone, or perhaps none in its body, wherein the vital functions are preserved by the office of more than a single heart,—which discharges an inky fluid from within for concealment amidst the waters,—and the eyes of which are opened by death,—seem to remove it far apart from the tribes usually brought under our notice.

No wonder, then, that the Sepia has been the theme of many authors, or that errors or prejudice have accompanied its history.

In certain districts the abundance of the Sepia facilitates the enquiries of the naturalist. In others, he is embarrassed by their variety in his neighbourhood, or the total absence in the seasons of migration. Thence nothing farther than correct delineation of living adults, accompanied by a few remarks on the progress of the embryo towards perfection shall detain us here.

The Sepia consists of two conspicuous principal portions, an elongated, or an ovoidal sac, containing the viscera ; and a number of living and strong arms beyond it, issuing from a common web or margin. The mouth is in the centre of these arms, which serve as feet when the animal is stationary, or as it advances. Then the bottom of the sac or bag is aloft or upwards, so that the mouth, eyes, and other parts constituting the head, are downwards amidst the roots of the arms or tentacula.

From these peculiarities, the race of Cuttle Fish is denominated *Cephalopode*—a name which, if explicable, means *walker* on the head. But it seems inconsistent.

Perspicuous details of the anatomy of various species of these animals will be found in the works of several distinguished physiologists, such as Martin Lister, the late Dr Alexander Monro, Dr Grant, Cuvier, Delle Chiaje, and others. The last has obviously had many specimens.

The subdivisions and peculiar nomenclature recently appropriated to them, may be also found in the works of the later authors.

Without dwelling on these minutiae, let it be remembered, that in a comprehensive view of the natural history of living animals, it is from common features—from something belonging to separate species,—that genera are constituted.

§ 1. SEPIA.—OCTOPUS VULGARIS—*The Eight Arm Cuttle Fish*.—Plate I.

This animal is of frequent occurrence in the Scottish seas, from March until November, within which interval it is sometimes taken by the oyster dredgers uninjured, as well as by other fishermen.

The examples are of various dimensions ; but, in as far as I understand, seldom diminutive, which argues their retreat from our shores, if these be the place of their nativity.

Specimens usually extend about eight or ten inches from the extremity of the sac to the extremity of the tentacula.

Only one has occurred much longer, as follows : Total extent nineteen inches ; length of the sac five inches ; from the extremity of the

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sac to the eye nearly six inches ; from the extremity to the upper edge of the mantle nine inches ; thickness of the body lying in a plate nearly six inches ; diameter of the longest sucker nine inches ; weight twenty-seven ounces.

The singular form, the arrangement and proportion of the different parts of this animal, will be much better understood from inspecting the Plate, than from any description. Among the most prominent features are two projecting eyes or golden orbits, immediately above the margin of the sac ; a wide mouth, spreading upwards, with eight tentacula surrounding it ; and a row of hard suckers clothing each of these from the root to the extremity. Towards the left side a tubular organ issues from within the sac.

On the side of the sac a narrow marginal fin is seen, in some specimens, as if dividing the back and belly.

The mouth of the animal is situate in the centre of the tentacula, the suckers of which consist of about sixty or seventy in adults of medium size. Probably their number and dimensions augment with age. But the row is single, though some naturalists, misled by that contraction of the parts concomitant on weakness or death, have ascribed two to the tentaculum. Then they are in a kind of alternate arrangement.

The predominant colour of this species is reddish-brown, brighter or paler above ; whitish below ; the eyes black ; the suckers white.

But nothing can be more variable or readier to delude the transient observer than the colour. Sometimes the body is almost of a uniform reddish hue, which quickly breaks into patches of different intensity, and is suddenly intermingled with white ; next it becomes speckled, or flashes again, then fading in cloudy evanescence.

These variations apparently result either from spasmodic affections, dependent on the health, or strength, or volition of the animal. After a specimen became motionless, pale, and to all appearance dead, a beautiful iridescence was displayed by the edges of the web, faint-brown spread over the back, and part of the tentacula, on being transferred to recent sea-water. All these faded again. Next, on transference to spirit of

wine, the body immediately became dark-brown, which was converted into dull-red.

Anatomists explain that the tube is an excretory canal. Water is powerfully discharged by it,—perhaps indicating the strength of the specimen.

As is well known, a black liquid is also discharged from the tube by this animal, whence it is frequently called the Ink Fish. Its use is doubtful, nor is there much probability of any truth in the ordinary hypothesis that it is for concealment. Nature, we have too often occasion to repeat, seems less solicitous about the individual than its genus. This discharge is sometimes profuse.

A specimen rather smaller than the figure was originally weak, though the eyelids were nearly close, and its adherence proved slight by the suckers. Its colour, faint tile-red, which became very pale in the evening. Having crawled out of the water, it did not adhere when returned; and the eye opened wide, then appearing set in a golden orbit. No symptoms of life were indicated next morning. Yet, on replenishment of its vessel, the red was renovated, especially towards the exterior of the back; and still, without any sensible animation, very black ink was discharged. In twenty-four hours the colour darkened again, remaining permanently as brick-dust.

All Cuttle Fish seem migratory. Probably they seek deep water in winter. Many are cast ashore in spring and summer, but probably in a weak or dying state. Then they never fail to excite the curiosity of the passenger.

I am ignorant of any representation of this animal from the life. Indeed, it is difficult to obtain a perfect delineation from a single specimen. When living, the eyes are little more than half-open, or appear only through a slit, the tentacula variously occupied, or in considerable regularity. When dead they are distorted, the eyes prominent and wide open.

PLATE I.

FIG. 1. *Sepia*—*Octopus vulgaris*.

§ 2. SEPIA SEPIOLA—*The Diminutive Cuttle Fish*.—Plate II. Fig. 1.

The preceding species is sufficiently common to admit opportunities for the anatomist ascertaining its structure, and of the naturalist discovering something of its habits. But, in this country, the *sepiola* is very rare—insomuch that only three have fallen into my possession in the course of twenty years—and these at considerable intervals.

The general formation of the *sepiola* may be compared to that of the *octopus*, under some organic exceptions in number and configuration; as well as in relative dimensions and proportions.

Total length of the animal thirty lines, from the convexity of the sac to the extremity of the tentacula: diameter seven lines.

As before it may be divided into three portions,—the sac, with the viscera; the head, with the eyes; and the tentacula, with the suckers. On each side of the sac is a large elliptical fin, like a thin oar, originating from the back, both being sometimes of such size that their edges would overlap if folded backwards, and are fitted to influence the motions of the animal. The tentacula are ten, being eight smaller and two much longer, with broad extremities, studded with a number of suckers. The smaller tentacula have two rows of suckers, at least the row seemed double, even while the subjects were vigorous. Then, the suckers of all species are cartilaginous, hard, expanding like a saucer. When globular, it is perhaps from weakness. The eyes are very prominent, of a deep blue colour by day-light, and of a fine green, set in a yellow orbit,—a tubular organ, as in the preceding, issues from the sac.

It is difficult to determine the true colour of the skin of this species—variable alike as in the other. While vigorous, I have seen the whole back transiently brown. Commonly it consists of a beautifully speckled brown or dingy yellow. The darkest speckling is on the extremities of the large tentacula. The specks are of every different form, and while the body is coloured above it is pale below.

The back of one of the specimens was at first chiefly a reddish brow, in large patches, subsisting until the evening, when beautiful vermilion speckling intermingled with them.

Every stimulus excites colour. The water having become fetid after the apparent death of another specimen, wherein the eyes had sunk, its body speckled, and the colours flitted on a supply of recent water.

The motions of this animal are rendered of easier observation, from its smaller dimensions. In common with its kind, the natural position of most living creatures is inverted—the part corresponding to the head being downwards, and the sac with the viscera elevated above. It swims in a retrograde direction, with considerable force, the tentacula extended nearly straight, and then of darkened colour. The wings flap together as if performing the office of fins.

This animal propagates in July. The spawn is produced as a firm gelatinous cylinder, an inch long, composed of a number of ova, from which the young have begun to escape on the first of August.

PLATE II.

FIG. 1. *Sepia sepiola*.

§ 3. SEPIA.—Plate I., Fig. 2.

Propagation.—The origin and progressive development of all animated beings, is a subject of profound interest to the philosopher, in contemplating the means whereby the vitality of the universe is preserved.

It is infinitely curious in the creatures with which we are now occupied, both from the peculiar form and the dimensions of certain species, and because the advancing organization is exposed with unusual precision to the observer.

In the larger and more perfect animals, the whole process is veiled from mankind. Elicitation of the spark of life, the source and the mode of evolution, the acceleration or retardation of organic form, its power and action, are the subject of conjecture alone, or deduced from appearances, too often fallacious, after all have been repressed by death.

Here, then, is an example how the general principles may be promoted through the medium of inferior beings.

V. III.

PL. II.



Sepia Sepiola

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The Cuttle Fish, like the larger proportion of the aquatic tribes, perpetuates its race by spawn, consisting of a cluster of longer or shorter cylinders or ovoids, with a rude resemblance to grapes, and thence sometimes passing by that denomination. These are exceedingly various in number and quantity,—clusters being seen of thirty ovoids attached to a common substance by their pedicles. Much irregularity and disparity subsist, probably depending on the species of the parent, its age or size. The grapes extend from one inch to three or four; the shorter of a cluster frequently of as great diameter as the longer. In a cluster of seven, they extended from nine to fifteen lines. The surface of the spawn is smooth, often of such lubricity that it can be scarcely retained in the hand; its colour dingy white or watery blue. It is transparent or opaque, according to the maturity of its contents, which, by their advances, raise the surface of the spawn in prominences.

Now, we find a striking correspondence with the propagation of some of the tribes of aquatic animals previously noticed. Like the spawn of these, that of the Cuttle Fish consists of an indefinite number of ova or capsules, each with an embryonic nucleus, imbedded in an albuminous mass. Also, as the nucleus is advancing, the swelling of the capsules augments the common mass, until the embryo issues forth prepared for independent existence.

An immediate parallel may be drawn between the evolution of the different tribes; and, could we discover it, the origin of life, and the progress of evolution, pervades animated nature under determinate analogies.

A grape of the spawn of the *Sepia loligo* was set apart for observation on May 15. It extended nearly four inches, with a slight curvature, and tapered slightly, one end being thicker than the other. In four days each ovum appeared to be a perfect sphere, containing an ovoid of much smaller dimensions, lying on the lower part within. Its place shifts with the altered position of the grape, and is always the lowest. It might extend equal to one-third of the diameter of the sphere; its thickness a fifth of that diameter.

From the expansion of the ova, the grape had enlarged three days subsequently; and, from the same cause, about twelve convexities rose

on the surface. In other four days, a prominence of one end of the internal ovoid became sensible, which I concluded to be the tentacula of the embryo that the ovoid indicated. But on account of the opacity of the mass under the microscope, minutiae are not easily ascertained.

About fifty ova could be now enumerated in the grape, in irregular stages of advancement. This seemed slower at the longer extremity, where many were huddled together.

In a fortnight from the beginning, the embryo had lost its ovoidal form. What I was induced to suppose the tentacula, then equalled about half the length under its new aspect. Of three embryos now delineated, two exhibited a red or golden speck, denoting the eye, and appeared on each side of this portion in two; but nothing was visible in the third. The whole embryo, lying now in an inclined position, were motionless. But in two days several were collapsing and shifting their position.

At this time the ova had much enlarged, and the contents were very distinctly exposed. Still, as before, the advance to maturity here and in other spawn was unequal, as may be seen from the figures, Plate II. fig. 2, four ova, with ovoidal embryos; figs. 3, 4, 5, embryos the farthest advanced, though unequally and varied, on June 1.

The same irregularity yet subsisted on June 3, when there appeared much disparity between the ova at the opposite extremities of the spawn. At the longer extremity the ova were three lines in diameter, and transparent, shewing the embryo recumbent, its eyes large and black, and the body now apparently consisting of three portions, occasionally in spasmodic contraction. This resolved into the semblance of slow pulsation, every six or seven seconds, in two days more, and minute red specks were evident on the embryo farthest advanced, which bent from side to side.

The intumescence of the ovum seemed great on June 7, compared with the progress of the embryo. Besides the eyes of the latter being large, and set in two fleshy oval orbits, though not in the middle, an internal black speck was exposed by some.—Fig. 6.

Many were far advanced on the 9th, and testifying impatience of confinement; yet none of at least twenty such escaped before the 12th, or thirty days after the commencement of observation.

The nascent Sepia extended about three lines. It was universally of a watery blue colour, finely speckled red; the eye large, round, black, and set in a golden orbit. It swam vivaciously in a retrograde direction through the water of a capacious vessel. The dimensions had sensibly augmented in the course of a few hours; yet the configuration of the external organs remained imperfect; the tentacula stout and triangular, curving towards each other; and the inside of the larger, when subjected to the microscope, appearing studded with suckers. Two delicate fins were on the convexity of the sac. But it is extremely difficult to apply such an object to the microscope, both on account of its size and vivacity. Whatever be the dimensions of these creatures, they constantly rise towards the surface of the water, and pursue their course around the sides of the vessel.—Fig. 7, Nascent Sepia; Fig. 8, the same, more enlarged.

The first animal was hatched in thirty days. It had burst the integument by the protrusion of the sac, followed by the head and tentacula. Other three, alike beautiful and vivacious as their precursors, escaped next morning, June 13. The eyes of these young animals, large, round, and black, are double the size of the ink bag. They are just at the root of the tentacula; and when the Sepia seeks the side of the vessel towards the light, they are of a beautiful green. The number liberated amounted to fourteen in another day, including one which died in the birth.

The figure and position of the organs were distinctly exposed by the microscope on the 16th. The two fins, resembling thin transparent leaves, with the most delicate veins, proved triangular, and affixed by the apex to the animal rather below the base outwards. Viewed from below, the eye was very large, both the pupil and iris, with a circular depression in the centre of the pupil. At this period only six of the tentacula were visible, with the rudiments of other two perhaps at the roots of the shortest. The tube may be discerned between the roots of the latter.

Some internal organization was likewise exposed by the transparence of the integuments. Two ovoidal masses, double the size of the eyes, appear behind them. This is lower, and towards the sac, supposing the tentacula upwards; and within the sac itself, towards the bottom, are the gills or branchiæ, if this name be appropriate to express internal

organs. They are divided into two compartments of curious form and arrangement, each consisting of about twelve thin lobes, originating from a stem somewhat like the rib of a feather, curving and diminishing as more remote. The pulsation of the heart, along with a pulsatory action of the branchiæ, seem going on, but without any semblance of circulation. It must be recollected, that much of the organic structure, and many of the vital functions, in nascent animals, are disguised by the transparence concomitant on their early stages; also, that their natural vigour is impaired by the exhaustion inseparable from being subjected to tedious observations. The ink-bag, though quite conspicuous, is too deeply seated for satisfactory microscopical inspection.

Nothing indicates the source of that speckling which now colours the body. It certainly results from some stimulus, whereby many of the young in the egg at once become speckled. During life the speckling flits about and disappears, as the nascent animal is enfeebled, motionless, and apparently dead. Black speckling seems the latest colouring with subsisting animation. The eyes of the living creature are a beautiful green. Fig. 9, a nascent animal, June 16, shewing the colours; enlarged. Fig. 10, nascent animal, more enlarged, shewing the internal organization. Fig. 11, inner surface of a tentaculum, studded with suckers enlarged.

The last of the young escaped on June 20, or in thirty-eight days from the commencement of observation. At this time the spawn had diminished considerably, as may be well understood, from the internascent ova having discharged their contents. The ovum becomes opaque on losing its foetus.

The young animal extends just about three lines, on production. I speak of that from the grapes most elongated: from others it is smaller. This creature issues through the side of the ovum, leaving the mark of its exit.

The substance of the preceding observations has been derived from elongated spawn obtained in May, and producing the young in June. Notwithstanding the discrepancies between the offspring and the adults of many creatures, the figure of the fins of the nascent Sepia would iden-

tify it as that lately named *Cranch's Loligo*. Its history, however, should be prosecuted farther.

The aspect of the spawn of the Cuttle Fish is extremely varied ; nor, without possession of the parent from which it is obtained, can we pronounce definitely on the species of several clusters procured on July 7, and 11. One of the latter consisted of at least thirty grapes, few, if any, extending an inch. A cluster of that of the former consisted of seven somewhat longer. These resembled an icicle, clearly exposing the contents as ova with the foetus, in various stages.

One grape, the most transparent, consisted of about forty minute separate and distinct spherical ova, each in the thinnest capsular integument. Others exhibited nine, ten, twelve, twenty, thirty-three capsules respectively, with the foetus in various stages of progress ; but they were not in any definite arrangement ; so plastic, nevertheless, that no space is lost among them. The contents of the grape with forty embryos were least advanced. In four of the others, the capsules, swollen to two or three lines in diameter, exposed the embryos stretched almost straight. These fell readily through the interior of their capsules, without any organic action, merely on shifting the position of the grapes. The same distension and internal rarefaction of the capsule succeeded here as before, and even to a greater degree, as evinced by the readier fall of the foetus. It may be asked, whether this intumescence does not result from the extrication of some gaseous matter preparatory for the respiration of the young ?

Fourteen or sixteen young animals having issued from the spawn, proved the protrusion from the sac first,—but that several nascent animals, unable to free themselves, perish in the birth.

The subsistence and increment of those creatures, visibly coming to maturity in the egg, is derived from the vitellus or yolk, as we denominate it, which is included within its own peculiar integument.

Each of the young Cuttle Fish is produced with a substance resembling a pearl in its mouth, at least so situate amidst the tentacula that they cannot close together. This substance may be recognised as the foetus approaches to maturity in the egg, when it affects very much the

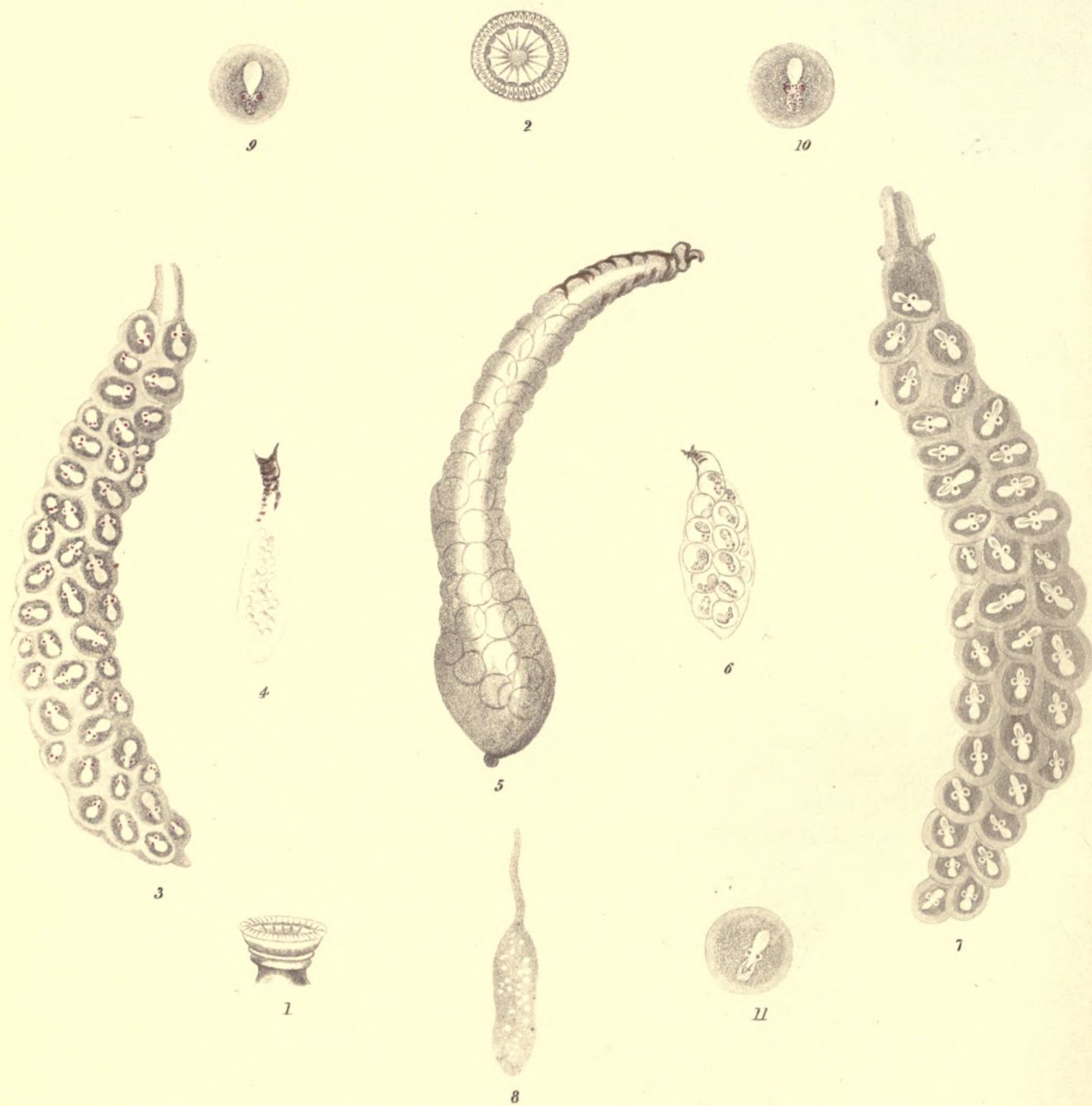
appearance of the animal. It seems to be the vitellus, or the integuments with the residue of the vitellus, which accompanies the young animal in its birth, and immediately afterwards separates, naturally, when it is discovered to be of a balloon shape, with the swell outwards. If the young animal dies on being produced, it does not separate, remaining *in situ*. Thus it appears when free, Plate II. fig. 12; and when retained, figs. 13, 14.

It is interesting to witness the diminution of the pearl in proportion to the enlargement of the body, just as the yolk of the egg is absorbed by the young chicken or the young skate in their progress.

When these creatures perish in the birth, it may be from the contents of the pearl not being sufficiently absorbed to allow the tentacula to close over it. One remained partly protruded during thirteen hours, and perished. The transparence of this young brood exposed pulsation sufficiently. A long oblique vessel seemed to discharge a colourless fluid upwards, into the parts connected with the neck or head. Many corresponding facts were demonstrated by the young from spawn, which I had reason to conclude to be that of the *Sepiola*. This was found in the immediate vicinity of fig. 1, presumed to be the parent.

At first it was dingy white or of a faint yellowish tinge, and apparently contained about twenty substances, irregularly globular. Motion became perceptible in two days, and two prominent black specks. In two or three days longer, the advancing foetus was speckled brown. A nascent animal, extending about an eighth of an inch, escaped on the first of August. As the tentacula are unequally or successively developed, I do not know how far the nascent *Sepia* of any species is to be identified with the adult. Here a similar intumescence of the ova had ensued: the motion of the young resembled that of those above described; and every stimulus tended to darken their colour. Seventeen embryos attained maturity: six remained abortive. The propagation of the *Sepia* ensues in June, and throughout the course of July. The embryos obviously require a considerable time to attain maturity. The nascent *Sepiæ* are very delicate: none of those from the large grape living above

TO VINDI
LIMBOLIAO



Spawn of Sepia

three days, nor any of those from the smaller spawn, which were not two-thirds of their size, surviving more than a few hours.

The ink is discharged soon after exclusion. To judge by the young there is no substantial ground for distinguishing the race as *cephalopode*, if to be rigidly interpreted. The tentacula, in as far as developed, are never employed as feet. The animals either lay flat at the bottom of their vessel or ascend the water, seeking the light by jerks from collapse of the body. I have sometimes, though rarely, taken similar nascent animals in the sea, which display the like peculiarities.

I have heard that some of the Cuttle Fish found in the æstuary of the Forth are esteemed a delicacy. It is certain that such is the case with those of the Mediterranean Sea; and it is said that at Naples various means are adopted to allure them into a net. They are reckoned the principal food of the Spermaceti whale,—a creature itself of gigantic dimensions.

Mr BEALE mentions one, on the shore of the Bonin Islands, having affixed itself to him, of which he got free with some difficulty. The body was about the size of the hands clenched, while the tentacula extended two feet.—*Natural History of the Sperm Whale*.

Others are said to have the faculty of springing out of the sea, with such force as to alight on the deck of a vessel, as mentioned by Mr Bennet, vol. i. p. 209; vol. ii. p. 290.

Large dimensions, those probably much exaggerated, have been ascribed to the Cuttle Fish, such as the body of some being the size of a cask, and the arms capable of clasping a man's body.

Mrs Broughton, in her entertaining account of a residence at Algiers, says,—

It was the custom of the family to bathe in a natural cave on the sea-shore. "On one of these occasions we were all seized with the greatest alarm, by my dearest mother screaming out, that something had seized one of her feet and was dragging her down into the water."

Being rescued, a large Cuttle Fish was discovered to have entwined its arms around her foot and leg, from which the attendants had some difficulty in releasing her.

"We were told," says the authoress, "that persons bathing have, from a similar rencontre, been drowned, the polypus having succeeded in bearing them down to the bottom of the sea."—*Six Years' Residence in Algiers*, p. 380 : London, 1839, in 12mo.

PLATE I.

Sepia octopus—The Eight-Arm Cuttle Fish. This should be viewed as with the arms downwards, being the natural position.

PLATE II.

FIG. 1. *Sepia sepiola*—The Diminutive Cuttle Fish.

2. Ova or capsules of Cuttle Fish, with the embryo in an early stage.
3. Embryo farther advanced.
4. Embryo still farther advanced.
5. Embryo considerably elongated.
6. Embryo in a swollen ovum, with the ink-bag visible as a black speck.
7. Nascent *Sepia*, having quitted the ovum, slightly enlarged.
8. The same, more enlarged.
9. Young *Sepia*, more enlarged; with the extended parts better defined.
10. Young *Sepia*, more enlarged. In these two are seen the alternations of colour, the aspect and arrangement of some of the internal organization.
11. Inner surface of a tentaculum, enlarged.
12. Pearl, or residue of the integument and vitellus amidst the tentacula.
13. Nascent *Sepia*, with the pearl.
14. The same, enlarged.

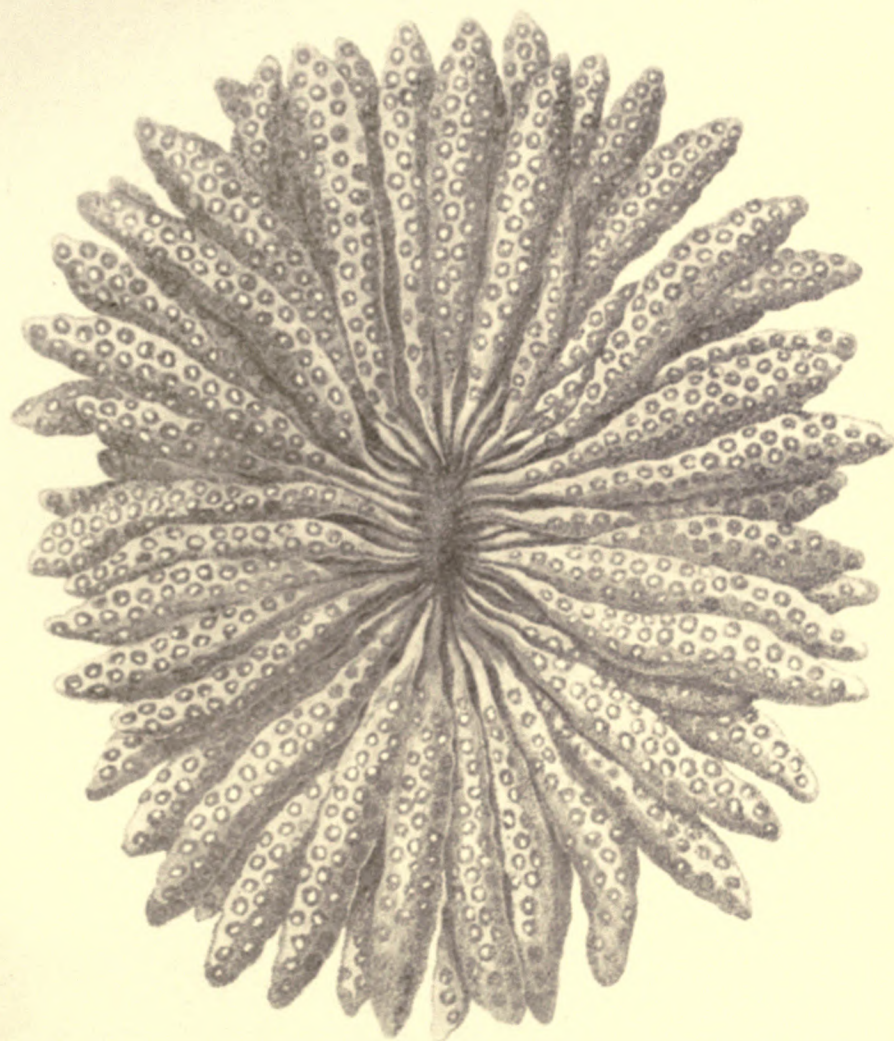
PLATE III.

FIG. 1. Sucker of Cuttle Fish in profile.

2. Sucker, as seen in front.
- 3, 4, 5, 6, 7. Spawn—parent unknown.
8. Spawn of *sepiola*?
- 9, 10, 11. Ova in different stages of developement.

PLATE IV.

Bunch of *Sepia* spawn.



Sepia
Spawn

CHAPTER II.

THE TESTACEA.

As if Nature beheld some of her children with greater favour than others, she has provided special means for their protection against wilful or accidental injury. So delicate is the organization of many, that it seems scarcely even safe from the pernicious influence of external impressions. Hence the means of protection may correspond with their liability to danger, rendering the slightest safeguard sufficient.

Some of the larger animals may inflict most deadly wounds, by teeth, by hoofs or horns; and the smallest may diffuse a deadly and irresistible poison, fatal to the greater part of the living beings around them.

Animals are provided with means and instruments, offensive and defensive. But the greater part are on such an equality in this respect, as to be neither superior nor inferior to others. Many are totally, and many but partially, protected; and it may seem singular that the most precious and important organs are unsheltered.

Thus no rational theory can be formed why Nature should have been so evidently solicitous for the preservation of one class of beings, while leaving others continually exposed to danger; yet to say it can have no object, would be alike presumptuous and absurd.

The shelter provided by nature is chiefly bestowed on the lower tribes. Though some are invested by shells, and others covered by spines or prickles, it is rarely that anything more is done than merely strengthen-

ing the ordinary integuments of the higher orders. This extends even to quadrupeds.

We speak of such safeguards as weapons for offence or defence. Are they truly designed as such? Perhaps, in our state of absolute ignorance of the fact, it might be more reasonable to say they are naturally thus provided with expedients which may be employed in injuring other creatures, and in protecting themselves.

Commonly their office seems for protection only; and in progress, from slighter means, it advances through various stages to great efficiency.

In the preceding Volume we have seen, that, by a peculiar process, which it might be difficult to explain, various humid secretions are diffused wholly or partially over the surface of many of the lower tribes. These secretions appear either as simple exudations, escaping from the entire surface, or distilling from the glandular concentrations, all as if to facilitate the winding of the animals among the crevices of rocks or stones. If glutinous, it combines with earth or sand, in slight temporary covering, or becomes a permanent dwelling, whither the tenant can retreat at will. By farther inspissation, a durable silken sheath is produced, affording ready and safe reception, which may be forsaken and resumed, or which may itself result on repetition of this natural secretory process. After numerous modifications of great interest and curiosity, a hard and resisting substance may invest the living being, impenetrable by its enemies, and sufficient to withstand the fury of the elements.

The original source of the various secretions, the mode whereby they are produced, their medium and means of application, together with their final purpose, are subjects for profound investigation. They are obviously derived from a certain definite organization, promiscuously distributed, or specially concentrated. They seem to be dependent on the particular circumstances affecting the privileged being, often involuntarily, but undoubtedly sometimes from volition, spontaneously exercised, and which may be often repeated.

But Nature herself, embracing a wider scope, anticipates all these latter alternatives, by providing the embryo with the rudiments of its pro-

tection. Thence does the shell originate in the ovum, or it may be coeval with the germ itself; and it accompanies the increment of the animal until liberated by birth. Nor does its tenuity expose the structure designed as a protection for the tenant, which affords the most interesting view of any forms employed for the mysterious office of sustaining life and advancing increment.

But the originating shell is not an exact type of its perfect and adult state: it is often more rude and shapeless. Herein it corresponds with the originating animal. Both are gradually refined into stronger resemblance of the product as matured by age.

The covering is progressively consolidated by new depositions, and it loses its early transparency, which has been so useful to the observer. New accessions augment the obscurity, and at length interception of this product with a superabundance of calcareous matter, altogether intercepts the view of the animal.

The safety of the animal is at last entirely dependent on the integrity of the shell. But it can repair many fractures by new secretions, though incapable of a total secretion to protect the body, if entirely deprived of the shell.

The greatest variety prevails, first in the form of shells; secondly, in the quantity of matter covering their form. But very little variety prevails among the testaceous animals themselves. I believe that I may affirm, that by far the greater part of shells belongs to an animal related to the *Limax*, or identically a *Limax*, and to animals with strong analogies to the *Ascidia*. Besides these, some others are found to be occupants of shells, whose history is less explicit. Where the position of genera or species is so much a matter of opinion, alteration and great modifications may be expected. It seems to be the same with the Testacea as with the Zoophytes: the animals inhabiting each exhibit little disparity, while their dwellings are distinguished by a remarkable variety of formation.

The multiplicity of inorganic infinitely exceeds the variety of organic forms connecting the two.

Among the animals so definitely recognised as pertaining to the Testacea, are some which we have distinguished as approaching, 1. the

Amphitrite or Terebella: 2. Those analogous to the Limax or the Doris: 3. Those to be compared to the Ascidia: 4. Those corresponding with the Tethys, a creature said to live free in the warmer climates, of which I can speak only on the authority of others, none without the shell being recognised as inhabitants of Scotland.

These are the principal animals of the Scottish Testacea. But there is very little uniformity among them; and although by generalization we combine the Ascidia with extensive genera, we shall find it vain to attempt identifying the species, from the great modifications of organization and aspect individually presented by them.

Neither do many strictly correspond with the animals taken as a type of the genus.—Naturalists are perplexed in determining the precise distinctions of several, such as the tenant of the *Dentalium*, and of the *Chiton*.

The univalve Testacea, dwelling in the Scottish waters, are not uncommon. In some lakes and ponds particularly, they are extremely numerous. On the contrary, the bivalves are in no variety, and they are extremely rare.

Very few bivalves comparatively belong to the fresh-waters of any country in Europe, but their number seems reduced very low in Scotland, insomuch that it is with some reluctance that any are presented before the reader.

The relation of the animal to the shell, must regulate those which shall be included with the Testacea. On this score, perhaps the *Serpula* and *Dentalium* are inhabited by animals which should be excluded.

Naturalists do not consider the shell as constituting distinctions among the genera of their inhabitants. Hence, perhaps, may appear the futility of the systems of Conchology, derived from the form of the shell alone.

But, however interesting many shells are, undoubtedly to the spectator, merely from form and beauty, such a system of Conchology cannot be admitted as a portion of the *Systema Naturæ*, for it would lead to very incongruous associations.

These facts, indeed, are of less consequence here. The Testacea did

not form any part of the subjects to which my attention was originally directed. I did not contemplate investigations of their nature. But as it is rare for extensive fields of enquiry of long duration to be confined within the bounds prescribed by any one to himself, accidental circumstances may bring important subjects under review.

The figures of a few living shells, therefore, are represented here, which is certainly the only suitable method of offering the Testacea to notice. Some of the examples are of great rarity, and difficult to be obtained, especially when entire and vigorous.

I have not attempted to keep any order here, therefore this portion of the work consists solely of miscellaneous observations. They are merely notes, accompanying accurate delineations of living specimens. The desultory form wherein what is said appears in this Volume entitles it to no higher consideration than so many transient notes.

Nevertheless, I feel confident that some utility will be derived from the quality of the figures. The authors who professedly treat of Conchology, even the most experienced, are hardly yet agreed on the precise position and arrangement of shells. Probably the subjects of their difference will ultimately prove trifling: Possibly too much weight is given to minutiae. It cannot be too often repeated, that the distinction of animals and their parts should be very decided. Strongly marked, infinite resemblances are general; yet, on descending to the minutest features, what two animals agree? If two leaves from the same tree never correspond, how can it be expected, amidst the variety of energies stimulating the increment of living matter, that all the parts of two different animals, such as may be visible or invisible to human sense, shall correspond *in omnibus*,—so great is the difference among the fingers of many persons, that we could hardly credit they belong to the hands of the individual; and sometimes there is no likeness whatsoever between the eyes.

Differences of animals should be therefore very strongly imprinted; and when they are so imprinted, they may be chosen for prominent features in distinguishing the genera and species which occupy the world.

Neglect of this has undoubtedly led to considerable confusion in the

arrangement of natural history offered for the guidance of students. Conchologists not having hitherto determined the precise arrangements of the Testacea, and modifications being daily proposed, render me less scrupulous regarding the methodical order of a subject which did not form a part of my original plan.

Besides the systematic arrangement of shells, the notice of naturalists has been directed to their constituent parts, whereby many beautiful and interesting facts are exposed. These will be found especially illustrated in a Treatise by an accomplished author, Dr Carpenter, in the *Cyclopædia of Physiology and Anatomy*.

Avoiding the nicer distinctions, we shall consider the Testacea as partitioned into two great divisions, the univalves and the bivalves: the former, where the animal has only a single shell, of whatever form, for its protection; the latter, where it is guarded by two, or enclosed in an impenetrable chest.

During the life of the tenant and in earlier age, many of the shells are vivid and beautiful; but their freshness and colour decay with its death.

The fabric and appearance also alter very much with age. Some, especially among the bivalves, gain great and irregular accessions; while most of the univalves have suffered abrasions, fractures, and other serious injuries.

Young shells continue to grow during a long time; and as their tenants obviously attain a very advanced age, the cessation of the increase seems quite unknown.

A regular traffic is carried on in shells in different parts of the world, which is liable to the greatest fluctuation; for shells, like some other subjects, being prized according to their rarity, the discovery of some previously unknown store produces an absolute revolution in the market. The price given for some such rarities, like that for certain old coins and medals, is little indicative of prudence, taste, or reason.

The finer shells certainly belong to the warmer climates. Many are of more curious form, and more vivid colours, than those of the colder countries: They also attain much larger size.

A few of our own country, however, both terrestrial and marine,

are sufficiently delicate and symmetrical, and of some interest, when we can discover the animals inhabiting them.

It is chiefly with regard to the latter, should there be an opportunity, that I desire to say a few words, and only as illustrating general principles.

The first step is to discover their precise figure,—a measure of apparent facility, but by no means so in reality, for it is seldom completely displayed. Moreover, the whole is momentarily so changeable, that there is some ambiguity whether it is totally displayed or otherwise.

SECTION I.—UNIVALVES.

Nature seems to advance by slight transitions through the great field of creation. If any great *hiatus* appears which cannot be occupied in the present state of knowledge, the animals originally preserving its continuity have probably become extinct with the lapse of time. It is not simply because years have rolled after years, that such a condition has occurred ; but because something leading to the destruction of life, on the cessation of evolution, has intervened in their course.

But the operation of such causes has not been equal throughout. In some countries the separate genera seem more definitely connected by intermediate links than in others. There the living creatures forming the chain, or part of them, still subsist. In Britain the interruptions are many. I doubt not that the researches of modern naturalists will tend to their diminution, and restore a portion of those legions swept away by time or pestilence. Meanwhile, organic remains testify how many have perished.

We generally assume, and with much appearance of truth, that the shell is specially designed for the protection of the tenant which is received into its cavity, and thus sheltered from injury. However, there are various species where very little benefit is in this manner derived from the shell.

Sometimes there is so great a disproportion between the body of the

animal and its shell, that the former, or a portion of it, remains constantly exposed, because there is not sufficient room for its reception. The shell may be so slight and weak where exposed, that it can afford very little protection to what is weaker than itself; or it may be entirely divested of its external characters, and be deficient in induration of any avail, by being imbedded in the flesh of the animal belonging to it.

§ 1. SIGARETUS.—Plate V., Figs. 1, 2, 3, 4, 5, 6, 7, 8.

The preceding facts are exemplified in the Sigaretus, which seems to be an animal interposed between the unguarded and protected, or between the *Limax* and the *Testacea*. It certainly participates of their nature, though it is not allowed to belong to either.

Its form, proportions, and appearance, prove it a *Limax*, such as distinguish the *Testacea*.

This creature, like the *Doris*, when viewed from below, is seen to consist of a head and a foot or sole.

Length of the body, from the tip of the tentacula to the posterior extremity, an inch; head distinct; tentacula two, rather cylindrical; a large black eye at the external root of each. Both the shoulder and the posterior extremity are rounded, and the whole body of the animal exactly resembles a *Limax*.

It is entirely covered by a thick somewhat fleshy cloak, very flexible, and spreading considerably over the body. The back is quite convex, the sole quite flat. The front of the cloak is extended at the will of the animal, in a fold narrowly resembling the syphon of the *Murex*, the *Cypræa Europæa*, and many similar tenants of shells.

When the anterior of the cloak is not prolonged, or perhaps according to the inclination of the animal, it is folded in such a manner, that one of the eyes is always directed through the slit.

The cloak is a covering similar to that of the *Doris*, and in crawling both extremities of the animal extend beyond it.

The *Sigaretus* swims supine.



Chiton

The under surface of a large fine yellow specimen is represented in Plate V., Fig. 1.

Most of the specimens which I have seen are grey. A small one is shewn, fig. 2, upper surface; fig. 3, under surface; fig. 4, tentaculum and eye, enlarged.

Grey specimens attain nearly the dimensions of the yellow ones. I have been unable to discover any important distinctions between them. If the syphon of some has appeared long, the body triangular, and the cloak expanding irregularly, it might be owing to the emaciated state of the individuals, or other causes. However, the cloak, owing to its colour, is more transparent than that of yellow specimens. A thin slough is cast off the upper surface.—Fig. 5, upper surface; fig. 6, under surface.

Under the cloak is a pure, thin, beautiful shell, of a very peculiar form. In real structure it seems to approach three rotates, the first perforated, the last very wide and flattened. A grey specimen having died, I committed it to a vessel of sea-water with a prawn, in hopes that the animal would be consumed, and the shell left entire. This plan succeeded. The same was done with another of an orange colour, which is not represented here.

In the *Sigaretus* it is the cloak which, by its projection, forms a snout.* In the *Tritonium undatum*, the *Cypræa*, and others, it is the flesh of the animal folded.

The creature is partly pelagic, partly littoral. It is not common.

PLATE V.

FIG. 5. Shell, back.

6. The same, face.

7. Shell of fig. 6, back.

8. The same, orifice.

* The reader will profit by consulting Cuvier, *Sur les Mollusques*, for the anatomy of the *Sigaretus*; also Montagu, in *Linneæan Transactions*, vol. xi. p. 186; and the observations of Dr George Johnston, in *London Magazine of Natural History*, vol. ix. p. 229.

CHITON—*The Boat Shell.*

The preceding are univalve shells in the strictest sense. Each consists of a single piece when in its perfect state, nor does the structure admit of more.

However different in form, all are inhabited by animals nearly of the same species—a *Limax*. But the organic arrangements of some are different.

Though perhaps not absolutely in its place, let us here introduce, for want of one more convenient, a few words relative to the *Chiton*, a multivalve shell, whose inhabitant is not very remote in its form and nature from the *Limacine* race, although it is not identified as one of the number.

Let the reader figure to himself an inverted boat, he will have a competent idea of the general appearance of this production.

The animal bears considerable resemblance to that of the *Patella*, and other univalves of the same description ; the two, however, are not to be identified. The shell of the *Chiton* is composed of several transverse plates, whereas those of the *Patella*, and other univalves of the kind, consists of a single piece.

Cabinets contain gigantic specimens from foreign climates. Those of the Scottish shores are small, but some of them are sufficiently ornamental.

In as far as I have observed, all are almost littoral, as they commonly dwell in very shallow water.

§ 1. CHITON FASCICULARIS.—Plate V. Figs. 13, 14.

As if this race of animals had been quite unworthy the attention of mankind, a sentence is seldom bestowed on its description.

Length of the shell nine lines or more ; figure a long oval, narrower and less regular than other species of the genus. Surface resembling

shagreen, consisting of numerous circular low prominences. Eighteen tufts, each composed of thirty-five or forty bristles, half a line long, like a stout thick brush, invest the margin of the shell, which consists of seven transverse plates. The animal is brown; head and body distinct. It consumes soft red rock; and gnaws the paper covering of its vessel. This last substance is likewise devoured when purposely introduced along with the animal. The motion of the creature is very slow. It adheres firmly and tenaciously to subjacent objects. The smoothness of the glass seems to allure above the surface of the water. But it will generally descend when left dry.

PLATE V.

FIG. 13. *Chiton fascicularis*, upper surface.

14. The same, under surface.

2. CHITON VULGARIS.—Plate V. Figs. 15, 16.

Length of the shell between seven and eight lines. Figure oval, composed of eight transverse plates, with a flat narrow margin, surrounded by a very short fringe. Surface like shagreen. Colour grey. The animal is dingy white.

It feeds on the common green fucus, copiously on the laminaria or tangle, and it may be occasionally found in considerable abundance on the shore where this substance is common. I have not observed it consume any animal matter.

The motion of this creature is very slow, the flexible nature of the shell and the transverse plates being free to slide on each other, admit of various curvatures, adapting the body to the irregular surfaces on which it dwells.

Spawn, consisting of numerous ova amidst albuminous matter, has appeared in the middle of October.

The common *Chiton* survives readily during a long time. As the plates of the shell are not connected by any ligament, they may be separated with facility after it dies, when their peculiar form is discovered to be different from what the superficial observer would infer.

PLATE V.

FIG. 15. *Chiton vulgaris*, upper surface.

16. The same, under surface.

Note.—Several species, which are but indistinctly characterized, inhabit the Scottish coasts, both mainland and islands.

Some of those are represented, Plate V. figs. 15, 16, 17, 18, 19. But none of them exhibit any peculiarities, or any very decided character. Indeed, I am induced to conclude, that on the whole, except in a few points, the Testacea are among the least interesting products of the creation.

Fig. 17, a native of Shetland, of angular form, is universally speckled and mottled, chiefly reddish-brown and dingy-yellow. The marginal border is divided into oblong rectangular darker and lighter compartments.

This animal dwells on rocky substances without apparent vegetation. Several individuals seated on a portion of such a rock, survived many months, continuing quite plump and vigorous. Numerous white pellets were discharged in their vessel.

These receded very slowly from the light. If the rocky fragment was reversed, so as to expose them below, they were afterwards found to have descended. The Chiton shifts its position slightly and rarely. Here the great inequalities and cavities of the surface of the rocky substances proved the flexibility of the plates of the shell.

PLATE V.

FIG. 17. *Chiton ruber*.

18. *Chiton lœvis*, upper surface.

2. PATELLA.—*The Limpet*.

A very comprehensive group among the Testacea was instituted by the earlier naturalists as the Patella, derived from the resemblance of the shell of various species to different utensils employed in domestic economy.

This group has undergone several subdivisions, according to the views of later naturalists. But as yet no solid basis has been assumed for permanent arrangement, thus leaving much perplexity regarding the proper position of certain species in the Systema.

This work does not profess a scrupulous adherence to the particular point of arrangement. It is rather devoted to the discussion of habits, at least it is so in a great measure, than to minute descriptions of the formation of parts. While the latter has been attended to by others, the former has been greatly overlooked and neglected.

At the same time, a general correspondence in the form of all the animals brought together in sections, is carefully observed here ; therefore none which are thus approximated can be in fact very remote.

ANCYLUS FLUVIATILIS.—Plate VI.

The habits of this animal bear great similarity to those of the limpet, so common on the rocks and stones of the sea-shore ; but it is an inhabitant of the fresh-waters.

Probably its name, *Ancylus*, originates in the presumed resemblance of the shell to a particular kind of shield known among the ancients. It seems to have been first given by Geoffroy, and afterwards recognised or adopted by *Müller*, *Historia Vermium*, vol. ii. p. 199.

Length of the shell three or four lines ; height above two ; form of the circumference a broad oval. The apex, slightly curved, is situate nearer to the posterior than to the anterior extremity. Colour tending to olive ; apex brown. Animal a *Limax*, or approaching that genus, of about the same length as the shell ; body broad, head large and distinct, with the mouth conspicuous below ; tentacula two, with a very black eye at the internal root of each ; colour slate-grey.

This creature is endowed with considerable activity. The sole, in crawling, extends somewhat beyond the margin of the shell ; and in passing over an angular substance, the body, relieved from the sides of it, then seems attached exclusively by that portion of the flesh forming the highest part.

The animal feeds on the confervoid aquatic plants vegetating on stony surfaces ; also on wood, as decaying branches, and on other substances.

PLATE VI.

- FIG. 1. Shell empty.
2. Animal, outline of the under surface.
3. The same, after nature, slightly enlarged.
4. Another specimen, under surface.

Reproduction.—The season of propagation extends from July, or earlier, through a considerable portion of the year, at least during the finer season.

In the year 1812, I made some observations on this subject, from specimens inhabiting the garden-well at Binns, which were repeated on others collected in the same place in 1836, meantime availing myself of those which could be obtained elsewhere. The most limited sphere is occupied for ages by the same race of animals, in their successive generations. Perhaps many of those which are free do not wander far from the spot of their nativity.

The spawn of the *Ancylus* is deposited in small, clear gelatinous spots, containing eight, or perhaps more, minute embryonic white specks. There is much disparity in the period required for their attaining maturity, being twenty-three to forty-three days, which might almost indicate some difference in species.

From specimens collected on September 16, an elliptical spot of spawn was produced on the 23d, containing two white specks. Each of these was in its peculiar capsule or compartment, as manifested on the 27th.—Plate VI. figs. 5, 6, the latter enlarged. The embryos had grown much, though they were rather shapeless, twenty-three days after the date of production; they exhibited slight contraction and expansion; and their two black eyes were very distinct. The spawn being affixed to the side of a glass vessel, left the sole or under surface of the animal next the eyes, the apex of the shell projecting inwards; now, the shell, which was pale silvery grey, seemed to be fluted.—Fig. 7, enlarged. Both animals quitted the spawn in another week, having attained maturity in thirty-three days.

Two specimens having been committed to a vessel in the end of



Ancylus fluvialilis.

July, they produced eight spots of spawn between the 6th and 15th of August. If equally prolific, four belonged to each.

These spots contained from five to eight embryos. Figs. 8 and 9 are represented to be of the natural size ; fig. 10 natural size ; fig. 11, the same, more enlarged ; fig. 12, spot natural size ; fig. 13, the same, enlarged.

The spot, figs. 10, 11, was produced on August 6, and two of the young quitted it on the 24th. Thus attaining maturity in eighteen days. One of those, contained in the spot, figs. 12, 13, which had been deposited on August 14, attained maturity on September 6, being twenty-three days.

The figure of the nascent animal is less definite than that of adults. There is still a greater difference in the shell. The shell of one while included in the spawn, seemed to be fluted. Nor was this an illusion ; it proved, in fact, to be so. But the fluting is probably obliterated with age. The shell of the nascent animal just specified of figs. 12, 13, though not a quarter of a line in diameter, was sulcated from the apex down to the margin, fig. 14. The same was equally conspicuous on the internal surface, which may be elucidated from the inside of another specimen as enlarged, fig. 15, and more highly enlarged, fig. 16.

Perhaps the whole spot of spawn may be itself compared to a capsule containing the individual ova, which seemed to be of a faint yellow colour.

The animal certainly renovates lost parts of the shell, where the losses are not destructive of the tenant, as was proved under favourable circumstances. A more distinct view of the contents will then gratify the beholder. Thus, the upper surface of the anterior of an animal surviving privation of half the shell appeared reddish, and a distinct view was afforded of the position of the eyes.—Fig. 17, enlarged.

These creatures seem constantly employing the mouth to besmear the neighbouring surface of the substances whereon they rest. They feed readily in confinement ; propagate also ; and they survive during a considerable period.

If contained in a small-necked or any other phial, and so are inac-

cessible, or from which they cannot be easily dislodged, the observer may obtain their transference, by merely inverting it in a more convenient vessel. They will descend slowly and gradually. But he must beware of allowing them to remain too long dry, which can be prevented by introducing a little water, and repeating the inversion of the phial until the creature quits it.

3. *ANCYLUS LACUSTRIS*.—Plate VI. Figs. 18–21.

Some authors seem to have confounded this species with the preceding, though the difference between them may be readily recognised on inspection of both at once.

Length of the shell two lines, breadth one, circumference of the orifice a long oval; the apex is considerably off the centre of the shell, being nearer one extremity; colour brown. This animal resembles the former; but it is smaller than the shell. Tentacula two. There are also two active flexible organs, curving downwards and over the body, as if in a searching manner. Eyes two, black, far apart.—Plate VI., fig. 18, *Ancylus lacustris*, viewed from above; fig. 19, under surface.

This animal feeds on the interior of the leaf of the common yellow Iris, and has occurred to me only in lakes and ponds.

Several specimens taken on June 25, from the leaves of the yellow Iris, were deposited in two separate vessels. On July 8, spawn was discovered, but of such absolute transparence, that it might have been produced some days previously, and have escaped observation. Now it would have passed unnoticed, unless for its resistance of the finger as a hard substance on the surface of the glass. By closer inspection, spawn was found on the sides of the vessel.

This spawn consists of transparent, hardish, round spots, containing from two to eight embryos. I have seen more with only one. Their presence and aspect may be described by shifting the position of the vessel, until suitable incidence of the light is obtained for exposure.

Each embryo, as before, occupies its own capsule, integument, or ovum.

In early stages the embryos were just discernible amidst the spawn;

they next become more distinct, as on July 7, fig. 20. Farther, by advancing increment, an elongated white shell occupies the whole space within the integumentary outline, as on July 17, fig. 21.

The young attain maturity in about a month, or within a few days less or more. They are very minute, pure white, and, to the eye, of a long oval shape. But under the microscope, they prove of a true regular oval; the animal greyish-brown, with its two black eyes distinct; and then there is evident pulsation of the heart. The margin of the shell at that time light-grey, spreads an oval border around its contents.

Here, it may be observed, that the figures of originating parts is affected by their transparence. A narrower or a broader oval on a regular circle, was determined more justly by the microscope than by the unarmed eye.

These animals have bred from the beginning of June to the beginning of August.

They are not so common as the preceding species.

PLATE VI.

- FIG. 1. *Ancylus fluviatilis*, shell, upper surface.
 2. Animal in the shell, under surface, outline.
 3. Animal in the shell, slightly enlarged.
 4. Another specimen, under surface.
 5. Spawn consisting of two ova, September 27.
 6. The same, enlarged.
 7. The same, farther advanced, October 20.
 8, 9, 10. Spawn with ova in various number and arrangement.
 11. Enlarged view of fig. 8.
 12. Spawn of August 23.
 13. The same, enlarged.
 14. Nascent *Ancylus* from the preceding spawn, back of the shell, enlarged.
 15. Exterior of the empty shell of an *Ancylus*, enlarged.
 16. The same, more enlarged.
 17. Adult regenerating the inner part of the shell in front, enlarged.
 18. *Ancylus lacustris*, upper surface.
 19. The same, under surface.
 20. Spawn, as on July 7, enlarged.
 21. The same, as on July 17, enlarged.

PATELLA VULGATA.

The Common Limpet, is diffused very abundantly on the shores of Scotland, as in many other countries. There it may be seen on the recess of the tide, adhering so firmly to the surface of rocks and large stones, that it can be rarely detached without injury. Many of the humbler animals know, without any monitor, how to affix themselves to substances adapted for resisting the fierceness of the surge, thence selecting an abode whereon they may dwell in greater security. Likewise they find, in the stunted products of such barren places, sufficient food to nourish them, though we can scarcely discover its nature.

The Limpet has a small head, with two tentacula of considerable length for its dimensions, with a black eye at the external root of each. The sole is round, applying its smooth surface strongly to subjacent substances.

This creature's shell is nearly circular in the orifice, perfectly conical, and of dingy white. The colour of the animal is dingy also, when of ordinary dimensions, or occupying a shell of about an inch in diameter. But, in a very large and fine specimen, two inches and a quarter in diameter, which, I believe, occurred in deep water, the body was of a beautiful yellow. The vertex of the shell was not proportionally elevated.

The anatomical structure of the common *Patella* has engaged the attention of various learned authors, among whom the late Baron Cuvier stands pre-eminent.

From the habits and position of the Limpet, the surface of its shell frequently becomes a nidus for the reception of the algæ and the serpulæ, particularly the latter.

In various parts of Scotland, this animal is taken for subsistence by the more indigent classes, though little relished on account of the reputed hardness and toughness of the flesh. It is likewise employed as bait, on a deficiency of that which is said to be more successful in the capture of fishes.

Several species of the genus *Patella* are found in Scotland, some of them meriting a brief notice on account of their beauty, and other peculiarities. But I shall restrict myself to a very few words on the subject,



Patella Pileopsis Cyprea

PATELLA PELLUCIDA.—Plate VII., Figs. 1, 2.

Shell an irregular ellipse, in the circumference conical, one end broader than the other, of a thin transparent horn colour, with, generally, four interrupted streaks of bright green radiating from the vertex to the margin, with darker intermediate streaks: animal light brown: head and body distinct; two tapering tentacula, with a black eye at the external root of each. The position of the head is under the vertex, or toward the narrow portion of the shell, and the body is covered by the broader portion. The margin of the under surface is environed by a border of short filaments. Specimens have little exceeded half an inch in length, and some, in favourable situations, are said to approach a whole inch.

This creature occurs on the common Laminaria at low-water mark, whereon it seems to feed. Probably it also derives sustenance from the confervæ, or other vegetation covering the rocks.

It is certainly among the most delicate of its race.

PLATE VII.

FIG. 1. Upper surface.

2. Under surface.

PATELLA UNDATA—*The Waved Limpet*.—Plate VII., Figs. 3, 4.

As the smaller animals of this genus are most common, they have been less the subject of observation; their reciprocal relations are uncertain; neither is it evident whether they grow much larger.

The margin of the shell of the Waved Patella the eighth of an inch in diameter, is somewhat of an elliptical form. Vertex white, with waving lines radiating down to the margin. The animal occupying the shell feeds on the Millepora. Perhaps the specimen represented may be young.

PLATE VII.

FIG. 3. *Patella undata*, enlarged.

4. Ditto.

PATELLA TESSELLATA.—Plate VII., Figs. 5, 6, 7.

The specimens of this animal, when young, are apparently of a regular oval form. The vertex of the shell is white, and four red rays diverge down to the margin of the upper surface. That of the under surface broadens, as is seen in some of the *Patella* tribe. It is tessellate, or composed of alternate dark and light parallelograms.

The animal is dingy white: the head broad and distinct.

PLATE VII.

FIG. 5. *Patella tessellata*.

6. The same, enlarged.

7. Under surface.

The vivid colours decorating such shells are not only liable to fade, but perhaps they merge in others, so as to render the accurate discrimination of species very precarious. Hence, some which are concluded to be distinct species, may be in fact only varieties. Some I have preserved a considerable time, without being sensible of their increment, which augments the perplexity.

It appears that the animals of the *Patella* tribe derive their sustenance from very scanty vegetable products. Perhaps they may consume harder substances.

PATELLA ?—Plate VII., Figs. 8, 9.

This is placed here provisionally. Before an accurate description of it was made, but after a good drawing, it was lost accidentally.

Diameter of the shell about four lines; colour greyish brown.

Animal a Limax, light grey: a black eye at the exterior root of each of its two tentacula. Marine.

PLATE VII.

FIG. 8. Shell, with the animal.

9. Empty shell.

The shell of the preceding animals is generally simply conical, contracting gradually upwards, and terminating in a vertex. Some others decline with less uniformity and regularity, and terminate in different kinds of recurvature.

The character of the preceding animals is also in common correspondence. The form of the *Limax*, however, is very variously modified, as well as the tenement wherein it dwells.

It would be vain to attempt accounting for such diversities, considering that its ductile body may be moulded to almost any form; and that its expansive and contractile faculty precludes its restriction to special space.

PILEOPSIS HUNGARICA—Plate VII., Figs. 10, 11, 12.

Shell nearly circular in the orifice, the diameter of which is about an inch; summit slightly recurved, obtuse; height about half an inch, striated down from the summit.

Two stout tentacula originate from the head of the animal, with an eye seated on the side of each. They become more slender nearer the extremities.

The animal was very inactive, remaining long stationary. One specimen survived about six months.

Pelagic: rare.

PLATE VII.

FIG. 10. *Pileopsis Hungarica*, animal, under surface.

11. Anterior portion, somewhat enlarged.

12. Shell.

VELUTINA LEVIGATA.—Plate VII., Fig. 13, 14.

It is doubtful whether this subject be one in transition to the flattened spiral shells, to the animals of which its tenant bears much resemblance.

Shell brownish, orifice wide, with a whorl originating on the side. Animal a *Limax*, tentacula two, with a black eye at the exterior root of each; sole long, extremity rounded; extent of the animal nine lines. Marine, pelagic; survives readily in confinement; rare.

PLATE VII.

FIG. 13. *Velutina lœvigata*; shell.

14. Animal under surface.

CYPRÆA EUROPEA.—Plate VII, Fig 15, 16, 17, 18.

The shell of no animal is more common as a subject of curiosity in this country, from the largest to the smallest species, whether foreign or domestic; yet no animal is less understood, or has been more rarely seen and described, than its inmate.

It is one example also, that, however abundant such creatures may be in their native haunts, they are found rare to us, desiring to obtain them alive, and to render them the subjects of observation.

The transitions of the animal tribes to each other, skilfully shewn in their anatomical structure by distinguished authors, are overpassed by those less sensible of the wonderful construction of the living frame, and who confine themselves to the study of living creatures exclusively.

Length of the shell half an inch; figure approaching an ovoid, deprived of the usual opening, in place of which is a wide longitudinal fissure, occupied by its tenant. The whole surface is finely indented by grooves, penetrating the edges of the fissure. Colour whitish; surface resembling porcelain.

The tenant of the shell is a yellow *Limax*, of remarkable dimensions compared with the size of its dwelling, extending an inch and an eighth, or above twice its length. Head terminated by a syphon or snout, folding longitudinally; sole very large, with a rounded extremity. Two taper, rather slender, long tentacula, having a black eye externally on the base of each, are in front. A dark cloak, unseen when the animal is in retreat, diffuses around the body as it issues from the fissure, and during its motion gradually spreads over the whole shell. It is somewhat gelatinous appa-

rently; not quite opaque, but of sensible thickness and consistence. In protruding, it appears first as a border around the orifice, then slowly and gradually broadening until closing above by meeting of the spreading edges.

The cloak is completely withdrawn to concealment with the retreat of the tenant of the shell.

I have not been able to determine this animal's food with any certainty. It is often in active motion, and always seeks the highest part of its vessel. Observing to renew the water frequently, it survives a considerable time. When much weakened, it retreats within, leaving the rim occupied by the cloak. Numerous empty shells occur in the Scottish seas, but very few with the inhabitant alive.

PLATE VII.

FIG. 15. *Cypræa Europæa*, shell; animal in retreat; cloak diffusing.

16. Animal in motion, seen from above.

17. Under surface.

18. Empty shell.

NATICA ALDERI.—Plate V., Figs. 9, 10, 11, 12.

Diameter of the shell under half an inch; the first volutes the largest, with a deep umbilicus. Colour whitish, speckled brown; surface very beautiful and delicate, of porcelain aspect.

The animal inhabiting it is of the nature of a *Limax*, disproportionately large compared with its dwelling. It extends eleven lines. Head truncate, in front thick, with a duplication of the skin towards each side on the upper surface of the anterior part. Two tentacula, like white thorns, one-eighth of an inch long, rise from the portion protruding, just at the edge of the shell. The anterior part of the animal is commonly smaller and narrower than the posterior, but less so in some specimens. The whole body is thin, flexible, and much resembling that of a large *Planaria*; yet more fleshy, and of a transparent bluish colour. The sole, in its whole extent, is one uniform portion, over part of which the head and tentacula project. The motion of the animal is equal, swift, and

gliding, always active when brought to the light. It swims supine, and so it ascends as high as possible in the vessel.

Perhaps this creature feeds on the Lobularia. Small portions of mussel within reach disappeared, and some shells have been emptied of their limacine tenants.

There are some peculiarities about it which I cannot explain. I thought one protruded a brownish stout proboscis. Specimens have survived a considerable time, several months, in my possession.—Rare.

PLATE V.

FIG. 9. *Natica Alderi*.

10. Another specimen.

11. Shell, back.

12. Shell, front.

TROCHUS.

Naturalists affirm that it is often difficult to distinguish the subjects of this genus from those of the Turbo; but the shell is more conical and elevated, and the operculum more horny.

I shall not embarrass myself with very nice distinctions in these miscellaneous observations.

1. TROCHUS CINERARIUS.—Plate VIII., Figs. 1, 2.

This is one of the more ornamental of the Scottish shells, both in form and colour. It grows to about eight lines in diameter, is of a grey colour, and darkly striated, so as to present the appearance of a reticulated surface.

The animal is approximated by general resemblance to the Limax.

Head roundish, with the mouth conspicuous below. Two long, slender, active, variegated tentacula issue from sockets with a dilateable edge, wherein they are retractile.

A black eye is on the external margin of each socket. The sole is a long oval. From each side of it issue three long slender tentacula, organs which testify a searching action, as is exhibited also by the real tentacula. A kind of fringe or cloak, somewhat resembling that of the *Doris*, projects a little from the body over the sole.

This animal feeds on the *Corallina officinalis*, both in its earlier and maturer state. It seems more common on the shore of some places where that product abounds. It is very lively, restless, and impatient; prone to quit the water, and crawl out of its vessel.

The observer will frequently see two slender, white, tentacular organs issuing from the vertex of the shell, and playing around it. But these are foreign to the animal: they are the tentacula of a species of *Spio*, nestling in a cavity there, which has been perhaps formed by accident, or by decay of the shell.

PLATE VIII.*

FIG. 1. *Trochus cinerarius*, viewed from above.

2. Under surface.

2. *TROCHUS ZIZYPHINUS*.—Plate VIII., Figs. 3, 4, 5.

Height of the shell, an inch; diameter of the largest volute, an inch; figure quite conical; volutes about six, each composed of smaller portions; colour reddish orange, finely speckled by a row of minute spots in the middle of each volute.

The animal resembles generally that of the *Trochus cinerarius*. Total length above an inch and a quarter; head very distinct, sole broadened at the shoulder, lower extremity obtuse. Six tentacular organs issue from the sides, as in the *Trochus cinerarius*. Tentacula two, extending half an inch in large specimens, slender, a black eye at the external root of each; colour yellowish.

This animal feeds on Zoophytes, as the *Sertularia rosacea*, and also on the common green fucus.

It is restless, and seeks the highest part of its vessel.

The shell sometimes grows pale, and becomes almost white.
Marine ; not common.

PLATE VIII.

- FIG. 3. *Trochus ziziphynus*, surface.
4. Under surface of the animal.
5. Shell.

TURBO.

This is a genus which comprehends numerous species, and seems to be undergoing dismemberment, in common with others of the less remarkable groups, because in a great measure destitute of characters sufficiently definite.

TURBO QUADRIFASCIATUS.—Plate VIII., Figs. 6, 7.

Length of the shell three lines ; volutes four ; colour brown, with four darker reddish belts. Animal a Limax ; head round, with two long slender active tentacula, in much motion. A black eye at the external base of each ; posterior extremity obtuse. An organ, half the length of a tentaculum, issues from each side of the broadest part of the sole ; colour grey, red, or brown, sometimes greenish, being derived perhaps from the nature of the food.

Margin of the posterior extremity white, in form of a horse-shoe.
Feeds on the Laminaria ; spawns in August.

PLATE VIII.

- FIG. 6. *Turbo quadrifasciatus* : Shell.
7. Animal under surface.

Note.—There are various other Testacea of much the preceding character, but of which the difference is not sufficiently marked to constitute positive distinctions. They are represented in the following Figures.



Trochus—Turbo



Physa fontinalis.—Limneus.

to find
attached

PLATE VIII.

FIG. 8. Upper surface.

9. Upper surface.

10. Under surface.

11. Upper surface.

12. Under surface.

13. Upper surface.

14. Under surface.

15. Shell.

16. Spawn of figs. 16, 17, produced in February.

17. Portion of the same, enlarged.

TURBO SENIOR.—Plate VIII., Figs. 18, 19.

I do not know that this animal has been previously represented. The specimen figured here was taken at Queensferry in 1811, while I was on a journey along the coast. Very diminutive at the time, it received little attention, especially from being left in the country, where it remained eleven months, without renewal of the sea water, its element. Nevertheless, it did not seem to have suffered much, becoming quite vivacious on replenishment of the vessel.

The shell was under three lines in length ; it had seven volutes, the last larger orifice nearly circular. Animal a limax ; tentacula two, long and slender, with a black eye at the external base of each. Upper part of the body black, under part greenish.

In the year 1819, the subject, as now described, was carried to Mr Patrick Syme, an artist distinguished by the accuracy and the delicacy of his pencil, for delineation. After experiencing much difficulty in finding it in a suitable position, he returned it in two or three weeks, saying it had crawled above the surface of the water some days previously, and was now dead.

I therefore resolved to puncture the shell, often an effectual remedy for revival, which should not be neglected by the observer, at least as experimental, when desirous of preserving his specimen.

Now, however, the subject recovered on immersion in recent sea water. It became vigorous and lively ; and having been committed to the artist a second time, the drawings, commenced in June 1819, were finished in May 1820.

No remarkable features were disclosed by the habits or the history of this specimen, longevity excepted. It survived eight years and eight months in confinement. Its only food was the green fucus.

Small testacea seem to suffer less than the larger, from renovation of their native element being neglected. A small Turbo, of another species, whose vessel had not been replenished during thirteen months, testified no diminution of vigour when water was supplied to it. Incidents are the result of accident, not of design.

The Turbo might have lived longer ; but being incautiously committed to the same vessel as a small marine Planaria, I entertain no doubt that its empty shell proved extraction of the contents by the other.

PLATE VIII.

FIG. 18. *Turbo senior*, natural size.

19. The same, enlarged.

The Limacine tribes dwell in the rivers, in fresh and in salt waters. They are numerous, and generally dispersed in most countries.

HELIX PEREGER (PEREGRINUS).—Plate IX. Figs. 1–4.

Modern nomenclature has so contracted the appellation of this common and well known animal, that ordinary linguists will be perplexed to identify their specimens, without reference to figures.

Length of the shell nine lines ; volutes four, the last disproportionately large compared with the rest ; horn colour or wax-yellow ; animal a limax ; sole broad ; anterior and posterior extremities obtuse ; head broad, almost a semicircular flap ; with two short, triangular, flattened tentacula ; and two black eyes almost at their internal base. Colour like that of the shell, Plate IX. Figs. 1, 2.

These creatures feed both on animal and vegetable substances, and consume the epidermis of each other's shells.

They deposit great quantities of spawn during summer, in portions of a rude cylindrical form, containing from five to fourteen ova or capsules, with a minute embryonic speck in each.—Figs. 3, 4. This, in the natural state, is deposited on leaves, and in confinement on the side of the vessel. Twenty days or more bring the young to maturity, when, on quitting the spawn, they are of the palest brown. Dwells in lakes and ponds.

PLATE IX.

- FIG. 1. *Helix pereger*, viewed from above.
 2. Under surface.
 3. Spawn.
 4. Spawn.

PHYSA FONTINALIS.—Plate IX. Figs. 5–11.

Length of the shell under half an inch; volutions four, the first three disproportionately small compared with the fourth; substance fragile, thin, and clear; animal a limax; head distinct, roundish; sole long and lanceolate, extending considerably beyond the shell; tentacula two, long and taper, differing considerably from those of the preceding subject; a black eye immediately in front of each. Three tentacular organs, often difficult to be seen, issue from each side of the sole; two of them, in front, are shorter than the true tentacula, cylindrical, obtuse, and very flexible. Colour of the shell honey-yellow; animal paler.

Like the others, this creature feeds on the equisetum, and other plants of the fresh waters which it inhabits, besides on animal substances.

Its disposition and habits, however, are very different. Its motion is swift; it is lively and active, apparently very contentious, and as if striking with the shell.

Spawn is produced in July and August, in masses nearly spherical, containing from three to eight ova or capsules, also nearly spherical, with

a central white embryonic nucleus. The mass is above a line and a half in diameter, very transparent; the integuments of its contents are hardly discernible from extreme tenuity. Each of the young has a very slow revolution within its own peculiar capsule, as advancing towards maturity. The black eyes are then visible, and the sole still clumsily projects from the body.

This animal begins to breed at an early age. In confinement the spawn is usually deposited on the side of the vessel, close to the surface of the water.

PLATE IX.

- FIG. 5. *Physa fontinalis*, viewed from above.
 6. Under surface.
 7. Shell.
 8. Spawn.
 9. The same, enlarged.
 10. Mass of Spawn, containing three capsules, with their embryos enlarged.
 11. Embryos in their respective integuments.

LIMNÆUS ?—Plate IX., Figs. 12, 13.

Length of the shell five or six sixteenths of an inch; volutes three, the first two very small; animal a limax, the length of the shell; form of the head obtuse; tentacula short; a black speck or eye near the summit; sole oval; colour greyish purple. Colour of the shell brownish grey; rare. Feeds on the decaying leaves of the iris. I have found this both on the margin of ponds and in the water.

A specimen which had retreated dry within the shell for six months developed itself when moistened with water; rare.—Plate IX. Figs. 12, 13.

MISCELLANEOUS.

FUSUS CORNEUS.—Plate X. Figs. 1, 2.

This is among the larger and more symmetrical of the Scottish shells inhabited by a limax.

V. III

PL. X



Miscellaneous

The shell has about ten distinct volutions, of which the last is infinitely the largest. All are very convex and prominent, enlarging regularly from the first to the origin of the last. The surface is somewhat smooth, of a faint brownish shade tending to cream colour. The animal is of the lightest grey or white, with a head rather small, and the sole very large, with an obtuse extremity; the shoulder broad, and the corners almost hooked. A black eye is seated externally on the middle of each of the two tentacula.

This animal dwells in deep waters, from which probably, on seizing the bait, it is frequently brought up by the lines of the fishermen. But either from natural delicacy, maltreatment, or some other cause, it survives a very short time in confinement; so that it is very difficult to obtain satisfactory delineations. The specimen represented is about half grown.

PLATE X.

FIG. 1. *Fusus corneus*, seen from above.

2. The same, under surface.

RETICULATED SHELLS.

BUCCINUM MACULA.—Plate X. Figs. 3, 4.

Length of the shell above half an inch; volutions seven. The surface is universally furrowed longitudinally and transversely, so as to resemble articulations. Animal a limax; sole large, triangular processes broadening the shoulder; posterior extremity indented by a notch. Tentacula large, with a black eye at the external base of each. As in others, the interior part of the beard is prolonged in a thin skin, folding longitudinally, so that, when the sides are closed, it resembles a proboscis. This organization, always protruding in front of the animal, equals the length of its body. It is often erect; so that, when the shell sinks among the substances below, the protrusion betrays its place. Colour of the shell and animal brownish.

This creature feeds readily on mussel, then protruding a real proboscis, which is short ; nor is other animal matter rejected.

It is active and vivacious, twisting itself in such a manner as threatens to tear the body from the shell ; meanwhile the long snout is far extended.

Specimens have survived fifteen months or more in confinement.

Some of the vermicular tribes prey on the mussel.

MUREX ATTENUATUS.—Plate X. Figs. 5, 6, 7.

Length of the shell four or five lines ; volutions six, ribbed longitudinally. Animal a limax ; a black eye at the external root of each tentaculum ; snout proportionally shorter than that of the preceding species ; posterior extremity obtuse ; colour of the whole light brown ; marine.

PLATE X.

FIG. 5. *Murex attenuatus*, upper surface.

6. Under surface of the animal.

7. Interior of the same, enlarged

FLATTENED SPIRAL TESTACEA

Among the more singular arrangements to be instanced of the disposal of nature, combining organic with inanimate matter, is lodging a living being in a cavity fashioned as a logarithmic curve, for its permanent abode.

The body of some of these creatures seems so disproportioned to their testaceous dwelling, according to our habit of viewing relative dimensions—the gait of the animal so unsteady, from its slight hold of the surface it traverses—independently of the respective position of both the tenant and its habitation being so much at variance with convenience

and safety—that it seems unaccountable how they should have been thus connected.

Yet as everything is harmonious in nature, and evidently the result of design, we are bound to conclude that some wise purpose contemplated this singular device, and thence suppressing conjectures that nature has erred, either in the true proportions or their utility, as our ignorance may have led us to entertain them.

Our knowledge of the Logarithmic Spiral Testacea is now confined to minute species comparatively, of which, if I be not mistaken, the greater proportion may be found in the fresh waters. But fossil remains bear testimony to the existence of very much larger shells, consequently their animals of this peculiar formation, scarcely any of which are known to exist in a living state at the present day.

Such are the *Ammonites*, of which numbers are dug from the bowels of the earth in different quarters of the globe. Some of gigantic dimensions may have inhabited the primæval world.

Those spiral shells yet preserved in miniature are not less curious and interesting. I have seen none but what are occupied by a *limax* or *helix*.

PLANORBIS INCONSPICUA.

This minute subject, if it could be identified with one which has been already described, is said to be obtained in a fossil state.

Figure flattened on both sides ; a logarithmic spiral, consisting of three volutions ; diameter under half a line ; animal a limax ; tentacula two, cylindrical, a conspicuous black eye at the external root of each ; operculum round ; colour of the shell amber-brown, of the animal grey.

Marine ; obtained by washing the fuci growing under low water at Eyemouth.

Among a number, none were larger ; all mere specks to the naked eye.

PLANORBIS SPIORBIS.—Plate XI., Figs. 1, 2.

Diameter of the shell four lines ; thickness half a line ; volutions five or six ; figure flat, resembling a very thick wafer. Animal a limax ; tentacula two, long and taper, with a black eye at the root of each. Sole short, with an obtuse posterior extremity. Colour of the animal reddish, whereof the shell slightly partakes.

In December, while the temperature of the water was 54°, the pulsations of the heart were thirty-two in a minute.

This species feeds on certain parts of the *Veronica Beccabunga*, *equisetum*, and other fresh-water plants. Some specimens have fed on oysters.

Its motion is slow and unsteady, owing to the disproportion between the sole and the size of the shell, which is always perpendicular to the plane of position. When the side of the shell comes accidentally in contact with the side of the vessel, it claps close, adhering immovably and beyond the power of the animal to relieve it.

The animal is incited to motion by the prevalence of a mild temperature and exposure to the light. It generally seeks the higher parts of the water. When crawling above the surface, the shell becomes unmanageable, adheres to the side of the vessel, and its tenant perishes.

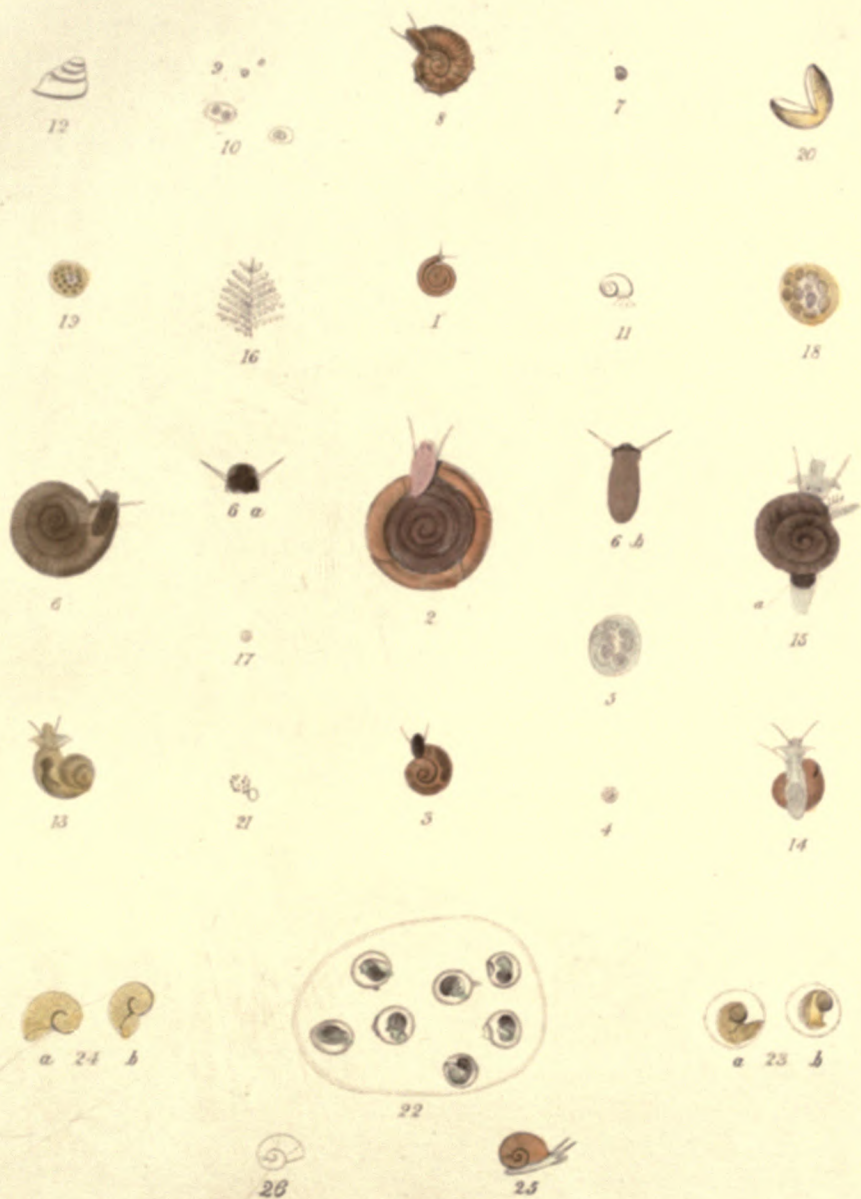
In the beginning of August the shell is often invested by parasite colonies of the *Vorticella*, whose multiplication is apparently repressed by repeated renewal of the water.

This little creature is very tenacious of life, and it survives intervals of desiccation which would be fatal to many other animals. Towards the end of August, a specimen was discovered with the side applied flat to its glass, wherein it had probably remained about two months. The body had contracted far within the orifice, therefore I removed a whole volute to reach its retreat. It was then immersed in water, while the temperature of the atmosphere equalled 59°. In two or three hours some small air bubbles escaped, and in other two, the animal, though very weak and languid, appeared crawling on the vessel.

Here it had been in a state of known desiccation, deprived of water,

V. III.

PL. XI.



Planorbis 1-10. Valvata Aluta 11-24.

for twenty-six days, and perhaps for the whole period above specified. A considerable time elapsed before it began to feed again.

I had previously observed that a specimen taken in 1811, and remaining vigorous in 1812, when left in the country, floated in apparent decay at the surface of the water in March 1813. I pierced the shell with a needle, at a part more opaque, at a considerable distance from the orifice, and removed the outside of half a volute. Then, tossing it back into the water, I was surprised next day to find the animal crawling on the glass. In the course of a fortnight it had made much progress in repairing the breach in its shell. But just before reaching the original part of the volute, the breach being of an intermediate portion, it retreated within and died. In this case had the repair of the breach been completed, the formation of the tubular would have been perfected, from uniting or connecting the two distant entire parts, which I was desirous to have witnessed. The renovated portion of the shell was distinguished by its extreme thinness and transparency.

On another occasion, after a specimen had adhered to the side of a vessel at least sixty days, in a state of desiccation, the animal had contracted a whole volution from the orifice. An opening being now made near the site of the head, while the temperature of an apartment was 54° , I committed the specimen to water at 62° . No symptoms of animation were betrayed during an hour, but in seven hours, the animal had protruded completely from the original orifice, which had remained unimpaired, and began to feed.

Naturalists have described the revival of such creatures after many years desiccation, which leads me to believe that a number of different specimens, removed from their native element, might be safely carried from distant regions for inspection at home. An occasional supply of salt or river water, or mere humidation, would suffice for preservation: nor is it improbable, that, in case of necessity and avoiding heat, they might survive desiccation during a long transit.

After revival of the dormant animal, the augmentation or repair of its dwelling seems dependent on the *quantum* of subsistence. The new portion is neither ever nearly as opaque as the old; nor is it of equal

diameter ; neither does the animal make any use of the fractured original parts for obtaining a perfect dwelling.

An albuminous mass of spawn, with four embryos, each in its own capsule, has been produced in the beginning of March. The earlier form of the young is an irregular spiral ; but the shape improves ; the eyes become visible ; motion is perceptible, and in twenty-one days the nascent animal quits its prison. But for a fortnight longer, the creature remains a mere white speck, which is transparent under the microscope. The tentacula then seem truncate or mutilated, and the eyes at their root, are black and globular. Now the orifice of the shell is wide, and the whole is void of symmetry.

Many examples prove the progressive advances of most of the Testacea to symmetry. Sometimes the young so resemble the adult that it might be mistaken for the offspring of a different parent. But all this may be compared to lower degrees of metamorphosis, such as we have described in higher stages.

This species had been the subject of observation and experiment in the year 1802, when I had favourable opportunities, continued for several years subsequently. Specimens were then readily obtained from a spot where the water afterwards failed, during an extraordinary drought in 1813. Not a single animal could be obtained either there or in the vicinity, from repeated researches for several years. At length on resorting to the same place in 1820, I found a new or a resuscitated colony dwelling in the water. Another drought followed in 1821, inducing me ultimately to regret that I had been prevented, by circumstances, from ascertaining whether the old animals had retreated into the earth, or whether only their ova had been preserved.

Specimens have survived eighteen months in my possession.

PLATE XI.

FIG. 1. *Planorbis spirorbis*.

2. Under surface, enlarged.

PLANORBIS RHOMBEUS.—Plate XI. Figs. 3, 4, 5.

The multitude of synonyms and the vague description annexed to

many of them, prove extremely embarrassing to the practical naturalist, who would identify the subject with that of his fellows.

Perhaps this may not be of equal use in a work designed as much for the elucidation of certain physiological points as for systematic arrangement.

Diameter three lines ; volutes four, but only three are distinctly visible. Orifice slightly oblique, considerably wider than the last volute in large specimens. The circular exterior of the volute is plain and uninterrupted by any keel or projection. Both sides of the shell are somewhat concave, owing to the decreasing diameter of the volutions, as more remote from the orifice. The animal a limax, with a sole about a line long, rather triangular, and a rounded shoulder ; the tentacula slender and pointed, with a black eye rather towards the front of the head at the external root of each. Shell light horn colour : sometimes, however, almost black. Animal darker than the shell ; sole very dark.

This creature feeds readily on the *Equisetum*, and, I believe, also on the *Veronica Beccabunga*.

On September 6, I took thirty specimens from Coldingham Loch. Their shells became much purer and cleaner in three weeks, owing both to the food and to absence of muddy matter ; and at the end of the fourth, the animals were exposed as transparent, and of a faint reddish colour.

Two spots of spawn, extremely transparent, were now observed in the vessel. One of them contained the embryos, some of which came to maturity, and escaped after an interval of from seventeen to twenty-seven days. The same period was confirmed by the observations of another year.

Fine specimens may be found under the chain bridge crossing the river Tweed, a few miles south of Berwick.

Specimens have survived above a year in my possession.

PLATE XI.

FIG. 3. *Planorbis rhombeus*.

4. Spawn.

5. The same, enlarged.

I am unable to identify this species with the *Planorbis rhombeus* of Turton, p. 108, fig. 90, as he describes the shell as "*striolate*," with a sharp keel near the base."

PLANORBIS CARINATUS—PLATE XI. Fig. 6.

Shell half an inch in diameter. Volutes five ; orifice oblique or irregularly elliptical. A sharp keel, commencing at the inner edge of the orifice, runs along the largest volution, near the base. Horn colour, sometimes almost black. Animal a Limax ; body nearly three lines long ; anterior truncate, posterior extremity obtuse.

One side of the shell is somewhat more concave than the other : the last volute enlarges considerably, so that the orifice expands two lines in its obliquity. The volutions are much striated, perhaps from receiving frequent accessions. The inhabitant feeds on animal and vegetable substances.

Varieties either want the keel, or it is almost obliterated.

The tenant of this shell is apt to assume such a place and position, that, from the disparity of its body compared with the shell, the latter is sometimes applied immoveable, like others, to the side of the glass. If retreating so far within the orifice as to be inaccessible by the water, it will revive after a considerable interval of desiccation, on a portion of the volute being removed to admit contact of the element.

There are certain peculiarities in the structure of this animal which I cannot explain. They do not seem referable to the season of propagation.

This animal feeds on the common pond weed, consuming the *parenchyma* of the leaf. Night is the great season of its activity : when, in a place where the species is abundant, they may be seen so occupied on a single plant. After their depredations, the leaf appears like net-work, and the whole exhibits a fine and picturesque object.

FIG. 6. *Planorbis carinatus* ; a, Head somewhat enlarged ; b, Sole somewhat enlarged ; Specimens feeding.



Planorbis Helix Carinatus feeding

PLANORBIS IMBRICATUS.—Plate XI. Figs. 7, 8, 9, 10.

Diameter of the shell a line ; volutions three, with transverse spinous ridges at intervals formed around the torsion of the epidermis. The intervals between the ridges are hollow. When free of impurity, the shell is grey or of a reddish tinge. Animal a Limax. Tentacula two, almost cylindrical, obtuse, incurved during progression. A black eye tenants the front of the head at the base of each. Sole oval. Colour of the animal dark grey. It feeds on vegetable substances, including the bark of beech and other trees lying in ponds and canals.

This creature spawns in February and in May. The spawn consists of very minute spots, generally containing a single embryo, and sometimes two. I have not at any time observed more. The spawn is imperceptible, unless when affixed to the side of a glass vessel.

Specimens have survived above eighteen months in confinement.

PLATE XI.

FIG. 7. *Planorbis imbricatus*.

8. The same, enlarged.

9. Spawn.

10. The same, enlarged.

VALVATA OBTUSA.—Plate XI. Figs. 11, 12, 13, 14, 15, 16, 17, 18,
19, 20, 21, 22, 23, 24.

Strictly speaking, this is not one of the logarithmic curved, flattened shells ; it more resembles the *Helix*es of our fields and gardens.

Diameter of the shell a quarter of an inch, height nearly as much. Volutes four, rising gradually in conical arrangement above each other, and concave below. Orifices circular, closed by an operculum. Animal a Limax. Length above a quarter of an inch ; head cylindrical, distinct. Sole, with a broadened shoulder recurving to each side, like some of the *Eolides* in the *Doris* tribes. Shortened extremity obtuse. A branchial

organ resembling a feather projects from above towards the lip of the shell, or a little beyond it, of which the best view is obtained by the animal endeavouring to regain a horizontal position, when the shell is reversed. One, or even several tentacular-like organs, as long, or longer than the true tentacula are alike active, sometimes appear farther down. Colour of the shell various shades of wood-brown, yellow or chesnut brown. Animal bluish grey. Feeds on the *Equisetum*.

This is a very vivacious active animal. It dwells in lakes and tranquil streams, from which it may be sometimes withdrawn in considerable numbers. One of its favourite haunts is between the lower folds of the yellow Iris.

There being either different species or varieties exhibiting very slight distinctions or peculiarities among them, these general observations are meant to apply to the whole in common.

The branchial organ is not uniformly shewn. Some shells appear smooth and shining, and there was considerable discrepancies in size and colour.

This creature spawns profusely during August, in small globules of a greenish or yellowish hue, and not half a line in diameter. The same individual spawns more than once. Each globule contains from about six to twenty embryonic specks.—Fig. 18 ; the same enlarged, fig. 19 ; other spawn enlarged, fig. 20.

The great season of spawning is the middle of August, when globules are seen on plants and stones. These are frequently so transparent as almost to elude observation when entire. But it is often produced on the sides of glass vessels, and is then very convenient, as affording good opportunities for inspection.

The spawn is contained in a hardish membraneous capsule, which gapes in discharging its contents, and afterwards appears empty, fig. 21. While full it is not seen so distinctly.

Some peculiarities attended the embryonic evolution.

The specimen, fig. 16, produced three globules of spawn on the 3d and 4th August, one of which is represented, fig. 20. On the 17th these

had enlarged to at least six times their original dimensions ; and on the 21st, some young had escaped from the third, thus requiring eighteen days to attain maturity.

When the spawn is originally deposited, as represented figs. 18, 19, natural size and enlarged, a considerable time elapses until it begins to swell. The embryos are now further dispersed, and more removed from each other, whereby they become much more distinct to view. The capsule is opening to discharge the albuminous substance whereon they are imbedded

Specimens taken on the 11th of August, afterwards spawned on the side of their glass in globules of the purest albumen, rendered greenish by the embryonic specks, each of which was contained in its own integument. These were considerably dispersed on the 24th by the swelling of the spawn, the capsule opening to discharge it, fig. 22. A portion enlarged appeared as fig. 23.

At this time the motion of the embryos in their peculiar integuments had commenced, and some were so far advanced, that pulsation of the heart was quite distinct. In two days more, one of the globules, originally half a line in diameter, extended three lines, still extremely transparent, with the embryos widely dispersed. Improving strength and organization enabled the embryo to pursue a course around the interior of its prison, fig. 24, *a, b*. But the shape was clumsy and less accurately proportioned than in the adult, though some of the organs were sufficiently evident.

Now the heart is seen as a vessel of absolute transparency, with distinct pulsation, as discovered from the sides or integument. No other internal organization can be clearly recognised, and this only when the subject is in certain positions. No cilia have been detected with magnifiers of considerable power.

Should the young perish soon after exclusion, their shells exhibits only a single complete volution, universally indented by circles, as if the whole were composed of circular rings, fig. 24, *a, b*.

The process of evolution above described is singular, and demands

farther investigation, and which will not be difficult, from the facility of obtaining specimens, and being of the season of propagation.

It is uncertain how and why the swelling and diffusion of the spawn succeed, whether by the generation of elastic fluids to exert or maintain the respiratory functions of the nascent being.

This species seems the natural prey of some of the leech tribe, especially the *Hirudo bin-oculata*. Neither does it escape the irresistible attack of the *Hirudo complanata* or six eyed leech. Numerous empty shells are confined along with living specimens between the lower parts of the leaves of the Iris, where also is the lurking place of their insidious enemies.

PLATE XI.

FIG. 11. *Valvata obtusa*.

12. Shell, slightly enlarged.

13. Specimen, upper surface.

14. Under surface.

15. Upper surface; operculum α .

16. Branchial organ.

The preceding figures 13-17 enlarged.

17. Spawn.

18. The same, enlarged.

19. Spawn, enlarged.

20. Capsule, empty.

21. Diffusing spawn.

22. Portion of the same enlarged, shewing the dispersion of the embryos.

23. Embryos moving within their respective integuments.

24. Empty shells of nascent animals.

CHAPTER III.

BIVALVE SHELLS.

THE preceding chapter being confined to miscellaneous general illustrations of the nature of a few inhabitants of univalve shells, the present one shall be devoted with corresponding brevity to some observations on a few of the bivalves, selecting for the most part those which are not difficult to be obtained.

But their features are not equally prominent. The former are constantly exposed. Their feeding and their breeding is generally patent to view. Both survive in confinement. The naturalist has to study little more than the season of the year to satisfy himself. It is different with the others. The food of scarcely any of them is known. Even under the most favourable circumstances, the spectator is denied a complete view of the inhabitant of the bivalve shell. None of its faculties are sensibly exercised, with rare exceptions, and if a scanty margin or the instrument of progression chance to have a temporary and partial exposure, the whole is suddenly withdrawn on the slightest alarm, while the opaque testaceous covering closes permanently over them.

Thus, the form, the habits, and the nature of the tenant of the bivalves are ascertained with much less facility than those of the others.

Nevertheless, conchologists have reared a system on no other foundation than the external covering, much easier, indeed, than if founded on the edifice and its inhabitant combined. What should we say of a discussion on the figure, proportions, and properties of a savage tribe,

deduced merely from views of the huts they have occupied? Here also is a new feature displayed in the cultivation of Natural History. To ascertain the precise position of his subject in the *Systema Natura*, the animal must be bereft of life, and the carcass scooped out of its native abode, to ascertain what description of hinge connects the valves of the shell,—this being judged one of the most important parts of conchology. The fit mode of proceeding, the selection of what is sufficiently prominent as the basis of systematic arrangement, must be admitted as difficult. But by following the preceding course, we spontaneously contrive an insuperable obstacle to elucidating the history of the living creature.

Combining the structure of the dwelling with the nature of its dweller, seems a preferable mode of promoting knowledge. Yet, I repeat, the subject is extremely embarrassing, and the wider the view we take it becomes the more so.

But no subject has been more ardently cultivated in its ruder state than conchology. Many have taken a deep interest, without any scientific object, in this subject, in its ordinary acceptance. The formation of cabinets, comprehending a complete series of the various genera, has been as energetically pursued as the exertions of the antiquary in collecting uninterrupted series of coinage to illustrate the history of kingdoms.

Hence have shells become an ingredient of established traffic, wherein the most extravagant prices may be lavished by the wealthy enthusiast. In truth the singularity and the beauty of some are admirable. But the prudence of costly purchases is, at the least, equivocal; nay, such an indiscretion sometimes generates its own censure, for the fortune of the adventurer for the acquisition of such stock has conducted him of later years to numerous broods of those previously accounted almost unique in the universe; and a few casks of the precious subjects of discovery have produced an absolute revolution in the commercial interests of both the merchant and the collector.

It is extremely probable that there are organic distinctions among the bivalves which have hitherto escaped the notice of the naturalist. Abiding by the most conspicuous difference, very few animals inhabit the bivalves, and, with exception of one, the *Ascidia*, or rather a creature

approximated to the *Ascidia*, none inhabit this country detached from the shell.

The genera of both univalves and bivalves are very numerous : great variety is seen everywhere in the testaceous covering.

The species are almost infinite : yet, let us look within ; most of the tenants, on cursory inspection, bear a common resemblance. The only difference seems to be in size. Thus it may be reasonably concluded that the true organic structure has passed overlooked : it has not been hitherto observed.

Many of the univalves are terrestrial ; they feed on various vegetable products, often so ravenously as to prove a real scourge to cultivators of the soil. All the bivalves dwell in the waters, whether fresh or salt : they sink among the mud or burrow in the sand.

I do not know that the animals of the bivalves feed on solid matter : they are not seen to consume visible substances, but their whole sustenance seems to be eliminated from mud and muddy solutions. Where those are abundant the stomach is full, the body enlarged, and the animals, of some kinds at least, remain plump and vigorous. Gratification is evidently derived from the presence of muddy solutions, and nutrition follows their absorption.

The greater proportion dwell in deeper water, but some are absolutely littoral, dwelling at or above low-water mark.

Some of the bivalve tribe, though not those of Britain, are the largest of the *Testacea*. Although some of the univalves of distant shores are of gigantic size, the bivalves far exceed them. Little, however, is accurately known of the precise natures of either.

None of the bivalves familiar to us are adapted by configuration to speedy motion. In general their progression is slow and laboured. Those that can advance have an organ, performing somewhat the office of a foot, protruding from the shell ; some spring through the way by the sudden closure of the two shells when opened, but many seem to have no farther power whatever than merely elevating the upper, as the shell rests or may be affixed to some solid substance, or is incorporated with it by gradual adhesion. There are some that change their

position by a strong muscular spring, wherein the foot is the most effective instrument.

Only a few of these animals exhibit the restlessness of many occupying the univalve shells, which advance with considerable expedition, and seem unwilling to remain long in any position.

But several enjoy the peculiar property of forming real threads, by which, as by so many cables, they anchor themselves permanently and securely to the same spot at will.

Thus, the locomotive faculty is, for the most part, very feebly and unequally dispensed. In some, besides, the portion protruding is so soft, so void of consistence, or so small, that, although inactive, it can be of very little use.

It has been already remarked that a glutinous matter lubricates the body of many of the softer animals. The purpose of this, in its simplest application, seems only for a protection from abrasion of the skin, by the indurated substances and uneven surfaces among which they dwell. Some aquatic animals appear as if suspended by an invisible thread amidst their element ; the slightest sheath invests the body of others, serving as a place of retreat, or for the shelter of others, and which is often secured by adhesion to solid substances. Some of the bivalves in particular are capable of producing quantities, smaller or greater, of strong conspicuous white, brown, or black thread, which may be compared to the work of some insects, especially the silk worm, as preparatory to quitting their imperfect stages.

By means of the secretory properties possessed by some of the lower animals, silky threads are extended, technically called the *byssus*, serving to secure them in the position they have selected.

This substance is various in quantity, colour, and tenacity. Some of the *Pectens* form a small, short, whitish *byssus* of weaker texture. That of the *Mytili* is brownish or blackish, larger and stronger. A bunch of stout coarse black hair seems to secure the *Modiolus* to its site, thence considerable force is necessary for detaching it. The threads of the *byssus*, issuing from the middle of the body, within the shell, are conducted to a certain spot by the organ which we compare to a foot, where it is affixed

by a broader diffusion. These enlarging diffusions are arranged after a particular disposition, according to the species of the animal, so that the cables anchoring the unwieldy *Modiolus*, stretch in lines quite different from the more slender cordage whereby the common edible Mussel seeks security.

However, this faculty is enjoyed by only a few of the bivalves: its benefit is hardly evident in some, nor do the great majority possess any such faculty in as far as can be discovered.

All the animal secretions are extraordinary. Those with which we are most familiar are involuntary, following the course of Nature by hidden means, but some are vitiated, in a manner leading us to believe that the organs appointed for that office are greatly affected, and incapable of fulfilling their wonted and proper purpose.

Secretion of the substance forming the *byssus* is undoubtedly the result of the faculty spontaneously exercised at the moment, if there be no reservoir for accumulation. If frequent, the resources certainly fail, and the animal becoming exhausted, the shell remains loose.

A faculty, apparently less spontaneous, but universally diffused among the bivalves, is the secretion of the calcareous matter composing their shells.

This secretion seems to originate with the embryonic state, as the spark of life is elicited. Its increase accompanies the evolution of the living being to more perfect form, and it is beheld in the nascent animal on escaping from the ovum. Then it is less symmetrical, but time refines it into due proportion when free and strengthened by existence.

Excellent opportunities of discovering the peculiar organization maintaining the vital functions, are afforded by its transparence concomitant on the earliest stages.

Certain of our domestic shells, particularly the univalves, are almost as fragile as those of the smaller birds' eggs. That of the *Physa fontinalis*, from which some rapacious leech may have extracted the contents, soon appears of the purest white, and almost as thin as tissue paper. Others, proportionally solid, seem capable of resisting external violence. The lower valve of a few of the bivalves is so fragile that I have never seen

it detached entire from the spot of adhesion, when its inhabitant always perishes.

If free of decortication, and the tenant vigorous, the shell receives occasional accessions, sometimes advancing visibly in confinement. The curious internal and external structure of some, which it is so interesting to behold, is understood to result from the peculiar organization of their respective tenants—rings, spirals, flutings, cavities, or projections. The structure of shells has been admirably illustrated of late by Dr Carpenter, a learned physiologist, celebrated for the high quality of his writings, and some other intelligent observers.

From age or circumstances the shell is incessantly undergoing progressive modification. The change is not great or very conspicuous in the mussel ; but the disproportion between the animal and the shell of the oyster is augmenting daily : and in older specimens it is very great. At first the shell is comparatively thin and delicate, and perhaps the animal preponderates. At length the shell becomes clumsy, large, and ponderous, weighing many times as much as its tenant ; while, further, the slight elevation of the upper valve seems to have no influence over it.

The size and quality of all such productions are very dependent on their site. Hence, while some increase and multiply rapidly in certain places, others may remain stationary and scanty—mere dwarfs in comparison. Nevertheless, this is one branch of their history insufficiently investigated.

It is from mud that the chief pabulum of the bivalves is derived. Various animals, of very different genera are, besides, dependent on the same source of aliment. I have not seen anything but muddy matter, or muddy intermixtures, in the stomach.

Certain sensations of the bivalves may be acute, but their instincts are imperfectly displayed, and their faculties, farther than opening and closing their habitation, together with the application of the *byssus* to use, hardly demonstrated : unequivocal symptoms show how sensible they are of dwelling in a grateful medium. Nothing is so essential to salubrity as repeated replenishment of their vessels with recent water. Though closely confined by their shells, the bivalves demonstrate the impression

received from the same fluid becoming stale or otherwise unsuitable for them. But, such conditions being too long protracted, the animals are at length exhausted: they can preserve the closeness of their shells no longer, the tenant, now languid, pines and perishes.

Seasonable supplies, however, avert the evil. Invigorated by their renovation, the animals close their shells again, and pertinaciously resist all forcible attempts to open them, until of themselves the edges begin to sunder, when the body protrudes as far as possible, and those endowed with locomotive faculties begin to exercise their power by crawling over surfaces below and ascending the sides of their vessels.

The bivalves are always evidently cherished and refreshed by the renovated element. How they are capable of sustaining protracted privation of this important quality, the freshness of the element, it should not escape the notice of naturalists, who would profit by domestic convenience, for inspecting interesting specimens from distant regions, as a single humectation on the way might prove an effectual preservative.

Besides demonstrating the gratification derived from the renovated medium wherein they dwell, the bivalves certainly show some sense of security in the formation of the *byssus* affording them protection. Not only is some solid spot selected for its original fixture, but confidence in the augmented number of threads, as a reinforcement to the place of adhesion, is indicated. All the other senses seem very obtuse and imperfect.

Notwithstanding the dissections of some skilful anatomists, it is doubtful whether the real structure of the bivalves is well understood.

1. MYTILUS—*The Mussel*.—Plate XII.

Did we rate the bivalve shells according to the real utility derived from them by mankind, probably the mussel tribes should have the priority.

The numbers consumed for food, and employed for bait in the capture of large and valuable fishes at the various fisheries, exceeds all calculation.

But all the species are not used indiscriminately, because some kinds are of unsuitable quality for consumption; and all animals having an election of the food they subsist on, others would prove of no utility in the fisheries.

MYTILUS EDULIS.

Many of the poorer classes dwelling in the vicinity of the sea, resort to mussels, as forming a large portion of their subsistence, in default of other and more costly food, and they find them sufficiently nutritious.

Some among the multitude, without betraying any sensible difference, are said to be deleterious, and individuals appear to have suffered severely from them. Unfortunately this subject is still very obscure. It is not explained what are noxious species, nor are the precise places whence they may be taken, clearly specified. Yet, I have heard some places named wherein I am not assured that any excepting the edible mussel would live. I have heard it alleged also, that metallic substances were in the vicinity of some, whereon families had fed, and which proved pernicious. No one has affirmed that the injury resulted from excess, as is far from improbable. If these animals absorb a quantity of mud, this ingredient itself is not to be thrown out of account.

The ordinary test of boiling the mussels along with a silver coin is easily adopted: if blackened, it indicates danger.

The edible mussel is very profusely dispersed over parts of the coast where there is an abundance of mud to be raised by the flowing tide, and in places where the water is extremely narrow. This animal seems always to dwell in very numerous societies, living half or nearly wholly sunk in the soft bottom. Whether of the same species or not I am uncertain, but it is found in multitudes only occasionally submerged by the tide, on such as large stones on the shore, or on stone piers, covered at high water, where many are so wedged together as to require some force to be dislodged. They very much resemble the edible mussel. I doubt whether their place is ever shifted. Possibly it is their sense of security in the numerous cords affixing them, that originally induced choice



Mytilus—Modiola



of the site, if not deposited there by the parent ; and the same sense of security leads to their association in thousands, though they were able to separate.

Mussel beds are sometimes very remote from each other. Therefore, the fishermen dwelling on parts of the coast where none are found, sometimes resort to places forty or fifty miles distant, for a cargo, to be deposited within high water mark, in their own district, whence they are removed for bait as required. Possibly, sufficient attention is not paid to the freshness of the bait, and to this the failure of fishing may undoubtedly be often ascribed. Many creatures utterly reject animal substances as food if stale.

The practice of transporting cargoes of mussels having prevailed very long in the same places, it does not appear that they are so favourable as to admit the growth of colonies there.

Small pearls, of sufficient purity, such as those technically called seed pearls, frequently occur in the edible mussel.

The surface of the shell, when the epidermis is removed, is of a beautiful blue, and receives a fine polish, preparing it for various ornamental toys, as made by persons residing on the coast of England.

PLATE XII.

FIG. 1. *Branchia* of *Mytilus edulis*.

MYTILUS PELLUCIDUS.—Plate XII., Fig. 2.

Extent fifteen lines. Shell smooth and thin ; stripes of yellowish hue and other colours radiate from the smaller extremity ; a fringe projects from the broad extremity. As the shell gapes muddy matter is absorbed, and it is discharged, but not in rolls, as by the *Ascidia*. A slender irregular byssus affixes the shell to solid substances. Some naturalists consider this only a younger stage of the *Mytilus edulis* ; and certainly corresponds much with it in form and habits. Others deem it a variety.

It is comparatively rare.

PLATE XII.

FIG. 2. *Mytilus pellucidus*.

MYTILUS POLYMORPHUS (*Dreissena polymorpha*).—Plate XIII*, Figs. 1, 2.

Whether this animal should be included here is questionable, for naturalists affirm it to be of foreign origin, and accidentally brought to our harbours, docks, and canals,—thence not a native species. Likewise its introduction is alleged to have been but of recent date. Whether these be facts, the animal is now naturalized in the canals of Scotland, as in those of England. Nor can much doubt be entertained that other Testacea are in the same predicament.

This species extends ten lines by six ; and is less than six lines thick. Its shape is somewhat like a stout wedge reversed, the acute angle above. Colour grey, with short yellowish streaks. The margin of the animal is fringed ; and, like the preceding mussels, where broader, may be arranged as if forming two cylinders, rising a line, dark and speckled. A whitish foot protrudes half an inch.

This is a very inactive animal. Dwells in fresh waters. At least the specimen represented is from a canal.

PLATE XIII.

FIGS. 1, 2. *Mytilus polymorphus* (*Dreissena polymorpha*).

2. MODIOLA.

Modern naturalists have dismembered the Mytilacean tribe of olden authors, to constitute a distinct genus under the name of *Modiola*.

MYTILUS MODIOLUS—Linn. (*Modiola modiolus*)—The *Horse Mussel*.—
Plate XII., Figs. 3, 4.

This is the largest of the race of mussels inhabiting the Scottish seas. The shell extends five inches and three quarters, by three inches ; and, together with its contents, forms a heavy compact subject. Colour brownish blue. The animal is large and fleshy. No marginal fringe is

present as in the *Edulis*. The flesh is reddish orange, that of the *Edulis* is yellowish. A quantity of strong black threads, like horse's hair, forms the *byssus* which secures the animal so firmly to solid substances,—as if its origin belonged to stormy seas. These are arranged with some regularity, and if they reach the sides of a glass vessel, the spots affixing their extremities are seen in a perpendicular line, whereas those from the *Edulis* are disposed more horizontally and with less regularity.

By removing a specimen fourteen or fifteen minutes from its element, the shell gapes and exposes the interior.

This species is often overspread with corallines, and many parasite productions indicative of its long existence. It is much more rare than the *Edulis*, and it dwells in deeper water. In certain places where it is sufficiently plentiful, the edible is said not to be found. I do not know that it is taken for food, or whether it is considered safe. Some anatomists search for the larger specimens, as favourable for illustrating the structure of the Mollusca, to which it belongs.

PLATE XII.

FIGS. 1, 2. *Mytilus modiolus* (*Modiola modiolus*)—The Horse Mussel, reduced.

MODIOLA BARBATA—*The Bearded Mussel*.—Plate XII., Figs. 5, 6.

Specimens of a mussel considerably smaller than the preceding, but larger than the *Mytilus edulis* or common mussel, sometimes occur on the coast, which are distinguished by their dull yellowish brown colour, and a number of spinous processes, especially on the broader part. Several authors consider this a distinct species.

If it is so there is little uniformity among the specimens. One extending two inches and three quarters by nearly an inch and a half, bore at least thirty on both valves; the longest rising an inch. These spines are much of the nature of thorns, springing from an enlarged long thick oval root.

On the whole, this species bears much resemblance to the *Modiola* in every thing, so that it is doubtful whether we shall judge it other than a variety, subject to the accidental formation of spines, from some peculiarity of the epidermis.

I have seen but one specimen, of small size, with spines. However, this favours the opinion of the *M. barbata* being a distinct specimen.

PLATE XII.

FIGS. 5, 6. *Modiola barbata*.

MODIOLA DISCREPANS—*The Corded or Corduroy Mussel*.—Plate XII.

Fig. 7.

Perhaps, doubts may be entertained, whether, in the most rigid distribution, this subject should be associated with either the *Mytilus* or *Modiola*, in their restricted application.

Shell a rude oval, extending eighteen lines by nine; dark bluish grey without, white within; thin and light. The surface deeply striated from the umbo of each valve to the circumference, particularly conspicuous towards the broader end, where the edges are crenate. It shines as if varnished. The foot of the animal inhabiting it is white.

This is the only shell of the whole testaceous tribes which the Scottish fishermen seem to account of any value. They offer nothing else: formerly, specimens were sold to collectors for half-a-crown.

The species is comparatively rare.

PLATE XII.

Fig. 7. *Modiola discrepans*—*The Corded Mussel*.

3. ANODON AVONENSIS (*A. cygneus*).—Plate XIII., Fig. 3.

Shell rudely oval; three inches and a half by two. Subject compact, heavy.

V. III.

PL. XIII.



Druissena-Anodon

The animal is thick, with a flat fleshy portion protruding as the foot, folding thinner over the shell, bearing much resemblance, both in aspect and motions, to the tongue of a quadruped. I have not observed it used as an organ for progression. The broader portion of the animal is formed as if into two cavities, the broader beset with external fleshy short processes.

Animal yellow. Shell darker and lighter shade of yellowish brown. This animal is plentiful in Lochend, near Edinburgh.

PLATE XIII.

FIG. 3. *Anodon avonensis* (A. cygneus).

4. CYCLAS CORNEA.—Plate XIV., Figs. 1, 2, 3.

Shell of somewhat globular appearance: three eighths of an inch in diameter—less in thickness.

Animal supposed of ascidian nature; large in proportion to the shell, extending about twice as much. The exterior consists of two orifices, in low conical prominences; the opposite portion protrudes as a foot. The animal is white: the shell darkens to horn colour, from age and situation. Young specimens, protected from mud, are transparent and whitish. Some adults also are very transparent.

The motions of this species illustrate that of the analogous genera. It is to be remembered that the *Ascidia*, with which we are most familiar, are stationary—necessarily so—from adhesion. But, in the present race, when the foot extends, it adheres and drags the shell towards its extremity, when another step is taken. Thence, the portion with the orifices is always behind; so that motion must be accounted retrograde.

Specimens have spawned in September, but the spawn, though advancing considerably, did not attain maturity. Several embryos are contained in the deposit.

It is difficult to obtain a complete and satisfactory view of the creature, which will often continue pertinaciously for a long time within the

shell. But, by allowing them to remain a day or two in stale water, and then replenishing the vessel with fresh water, they quickly expand and begin to crawl.

They dwell in multitudes in Lochend ; some under stones. Many among the folds of the yellow Iris, and, on drawing up the roots, an hundred empty shells, along with some living specimens, may be readily obtained.

PLATE XIV.

- FIG. 1. *Cyclas cornea*, in motion
2. Spawn, enlarged.
3. The same, enlarged.

5. TELLINA.—Plate XVII., Fig. 8.

A distinct illustration is afforded of the active powers of some of the lower animals by this subject.

The shell, rudely oval, might be circumscribed by a broad ellipse, extending an inch. The edges are smooth : the colour almost white. The animal, also white, bears considerable resemblance to the preceding ; the anterior part, protruding in a conical form, terminates by two orifices, scarcely forking asunder ; one of them fringed ; in the opposite extremity, prolonged as a slender conical foot. The total extent of this animal is about two inches. It is to be recollected that the whole body of the creatures inhabiting bivalves is commonly contracted, and the shell closed firmly around it.

But this latter extensile organization is not employed as a foot, according to the nature of many other bivalves, which open very gradually, and slowly protrude their parts. Here, the white extremity, as it issues, testifies a very active searching motion. Stretching to the utmost, the animal suddenly springs away amidst the water. Its motions are vehement and instantaneous, so that it seems ready to spring out of the vessel.

V. III

PL. XIV



11



4



8



12



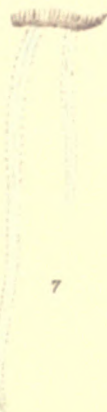
13



14



6



7



9



3



2



16

15



1



10



5

Cyclas-Venus &c

I have not seen any of the bivalves endowed with a similar faculty in shifting them by the same expedient. Those with a foot use it in crawling, if it is of sufficient consistence, power, and dimensions. In many, however, these conditions seem to be deficient.

PLATE XVII.

FIG. 8. *Tellina*.6. VENUS VIRGINEA (*Tapes pullastra*).—Plate XIV., Figs. 4, 5, 6, 7.

The shell, of irregular outline, may be circumscribed by a broad oval of an inch and a half by an inch. It is of light brown colour. The animal, nearly white, protrudes the anterior nearly two inches, the extremity forking into two cylinders, with a fringed orifice in each. A broad thin foot, seldom seen, protrudes behind.

This subject is affixed by a strong light coloured silky *byssus* to solid substances.

It seems to be from inconvenience that the animal retreats and closes itself up in the shell. Its greatest expansion is at night. But it is induced to protrude during the day by covering its vessel.

PLATE XIV.

FIGS. 4, 5, 6, 7. *Venus Virginea* (*Tapes pullastra*).

VENUS CASINA.—Plate XIV., Fig. 9.

This shell is by no means uncommon along the Fife coast, and about the Isle of May; but it is rarely found alive, at least I have found it so.

A living specimen was received on the 22d April 1845, and continued to live until the 17th April 1848.

It had ceased to open the shell for months. Nevertheless, I did not think the animal dead, from the weight of the shell. But it shewed

no demonstrations of life. I endeavoured to separate the valves: they seemed to have some artificial adhesion by the edges. When the valves were separated, the animal seemed quite fresh, not in the least decayed; and, put into recent sea water, the frills swelled. But the foot did not stretch; nor can I say there was any vigour that would have opened the shell.

PLATE XIV.

FIG. 9. *Venus casina*.

7. *MYA STRIATA* (*M. truncata*).—Plate XV., Figs. 1, 2.

Shell rudely oval, extending two inches by one and a half. Colour brownish grey. Animal somewhat of ascidian nature, and bearing considerable resemblance to that of the *Pholas*. It is very large in proportion to the shell, extending in whole about six inches; the anterior terminates in two low fringed orifices, of which the larger is two lines in diameter; the opposite extremity, a white foot protruding behind. A dark thick rugous skin, like an epidermis, covers the animal, with a longitudinal narrow cleft, exposing the white flesh within.

This animal is very quiescent. It squirts the water two feet from one of the orifices.

Only two specimens have occurred, both of nearly the same dimensions.

PLATE XV.

FIG. 1. *Mya striata* (*M. truncata*), side.

2. Foot and cleft.

8. *PHOLAS CRISPATA*.—Plate XV., Figs. 3, 4, 5, 6.—Plate XVI., Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Two species of this genus are the more frequent in the Scottish seas, the *Pholas crispata* and *P. dactylus*. There seems little difference in



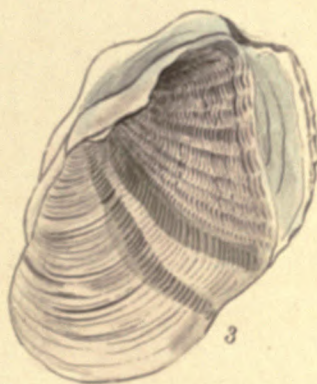
6



4



7



3



1



5



2

Pholas crispata - *P. dactylus*.

their nature. Both inhabit the same beds of indurated clay, within the flood. There they form cavities, where they retreat with the ebb of the tide, and whence they protrude as it flows.

Length of the shell twenty-five lines ; width fifteen, as in a line with the animal. It seems an absurdity in description to speak of the diameter of a tubular cavity as its length and the length as the breadth. A large rib originates within, just under the umbo of the shell, and projects half an inch from each valve. These ribs have a curvature corresponding with the cavity of the valve.

The animal of the *Pholas*, like the preceding, seems of ascidian nature. The anterior is prolonged in a round form, and terminated by two fringed orifices, separated by a short cleft : the posterior extremity protrudes slightly, as a large round fleshy bulb or button, with a smaller neck. The whole length of an animal, with a shell such as that above described, is not less than four inches or more.

Colour of the shell grey, of the animal white ; the summit of the body, orifices, and fringe, variegated with brown. A thick, dark, rugous integument invests the body as an epidermis, for a considerable distance from the shell, wherein a very narrow cleft is likewise perceptible, exposing the white flesh within. This integument belongs more particularly to larger and older specimens.

In captivity, the *Pholas* testifies little sensation or motion, remaining constantly in the same place, and exhibiting merely extension and contraction. When healthy it protrudes far from the shell ; and its dimensions seem dependent on the quantity of sea water absorbed. It is impatient of light—contracting even on the vicinity of a candle.

In the natural state it must be very quiescent ; for a specimen of the *P. crispata* occurred amidst a lump of soft sandy formation entirely investing the shell, wherein only a small aperture remained for protrusion of the body. A fisherman also brought four specimens of the *P. dactylus*, much whiter and cleaner than usual, which he affirmed he had found on breaking up a piece of chalk.

The peculiar formation of the shell is such as to fashion a cavity by any motion it receives from its tenant.

PLATE XV.

FIG. 3, 4, 5. *Pholas crispata*, shell.

6. Specimen extended.

7. *Pholas dactylus*.

PLATE XVI.

FIGS. 1-10. *Pholas crispata*.9. PECTEN—*The Scallop*.—Plate XVII., Figs. 1, 2, 3, 4.

This is a numerous genus of bivalves, comprehending subjects much varied in dimensions, form, and colour, which could be specified only by long enumeration.

There seems a general resemblance to predominate among the animals dwelling in the shells, which, without sufficient authority, have been compared to the *Tethys*, one whose nature is little understood.

The shells of all are flattened, thin, and light. Some at least three inches in diameter, down to very small dimensions; with two ears at the hinge, equal or unequal in relation to each other. The surface of the shell radiates in flutings, from about the hinge down to the circumference.

PECTEN OPERCULARIS.—Plate XVII., Figs. 1, 2, 3.

This shell attains three inches in diameter; it is of flattened form: one ear somewhat less than the other. The ribs or rays exceed twenty; they are about twenty-three; convex above, hollow below, that is within the valve. Colour dingy white, or variegated vivid red and white. The animal appears thick as the valves open; its circumference is studded with a numerous row of resplendent green ocelli on each lobe. Numerous long tentacular organs likewise issue from the margin, with many interior short fibrilli, like slender teeth, directed inwards. A short white foot protrudes from the shell, which seems to aid smaller specimens only, to their position.

F. III.



8



9



6



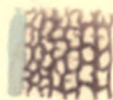
10



1



4



7



3



5



a



b



2

Pholas crispatus

This animal affixes itself to solid substances by a white or grey silky *byssus*.

The *Pecten* is one of the most restless of the Testacea. It springs amidst the water, sometimes striking the vessel so violently with the shell as to threaten fracture of the glass. The fishermen affirm that this animal is seen springing through the sea in like manner, which is the quickest mode of shifting its situation. As this is effected by sudden and forcible collapse of the valves, if the observer commit his specimens to a shallow vessel, he will soon find it almost completely emptied of the water.

Small specimens generally ascend the side of the vessel, where, anchoring themselves, they readily survive; or, some take the same precaution at the bottom. But, large specimens are of more difficult preservation.

When quiescent and undisturbed, the scallop opens, displaying its beautiful parts: the thick margin studded with two bright ocelli frills; and tentacula of surprising length. The latter extended above an inch from a specimen but half an inch in diameter. The margin is half an inch deep, in a specimen of two inches. I speak of the *Pecten* in general, not of the *P. opercularis* only.

PLATE XVII.

FIGS. 1, 2, 3. *Pecten opercularis*.

PECTEN OBSOLETUS (*P. tigrinus*).—Plate XVII., Fig. 4.

This is one of the smallest species of the genus, as it might be circumscribed by a circle an inch in diameter. The surface of the shell is wholly striated; faintly towards the hinge, more conspicuously towards the circumference. The left ear is by much the larger. Colour of the upper surface red brown; of the under surface brownish purple red.

The margin of the animal is studded with beautiful iridescent ocelli, on both lips, as may be seen by the shell opening on a supply of recent water. Numerous tentacular organs, some extending two or three lines,

issue from around the whole circumference, except at the hinge, which exhibit an active, curving, searching motion, in all directions.

This animal affixes the narrower portion of the shell, by a white silky *byssus*, to the upper part of the containing vessel. When active, it springs with great force through the water.

A specimen survived above four months. It is rare.

PLATE XVII.

FIG. 4. *Pecten obsoletus* (P. tigrinus).

10. PECTUNCULUS PILOSUS (*P. glycimeris*).—Plate XVII., Figs. 5, 6, 7.

Shell of globular aspect ; substance thick, strong ; subject massy and heavy. Might be circumscribed by a circle of two inches diameter. The umbo prominent, is situated a little towards one side. Surface wholly furrowed, with fine hollow lines, from the umbo to the margin. Alternate dingy white, purple, and brown patches, are disposed in zig-zag arrangement on the surface. Towards the margin the shell seems hairy. Colour of the animal mottled brown. Numerous minute black specks stud the fleshy margin, which protrudes little : unless the lower portion, of white colour, which protrudes farther, and folds downwards, in a large mass, exactly resembling that of the *Anodon avonensis*, and extending two inches, by three quarters of an inch where thickest.

This animal remains in absolute quiescence. During four months I was not sensible of it ever making the slightest effort to change its position.

PLATE XVII.

FIG. 5. *Pectunculus pilosus* (P. glycimeris, Linn.).

6. Margin of the shell, enlarged.

7. Compartment of surface, enlarged.



Pecten-Pectunculus &c

SOLENI SILIQUA—*Razor Shell*.—Plate XVIII.

With a view to studying the living creature, I had, on the 19th of July 1844, seven specimens brought to me ; and, with considerable surprise, therefore, I found its nature and organization entirely different from what, owing to some erroneous figures, I had supposed.

The whole product is about five inches long, consisting of a bivalve shell, slightly arched at each end, opening down the whole front, the valves being connected behind. A transverse section would be an irregular ellipse,—broader behind than before. The shell is of twofold formation, divided as it were into two long triangles, of darker and lighter surfaces. The former, being the back part, exhibits the accessions conspicuously by transverse edges.

The animal inhabiting this shell is almost identical with that of the *Pholas dactylus*. A broad shoulder projects above, with two prominences, having a larger and a smaller orifice. The former, the larger, is guarded by a double fringe, and forming the edge of the margin : the other environing its external base. The edge of the smaller or excretory orifice is smooth ; but its external base is fringed. The portion of the flesh where the orifices are situated, and the orifices themselves, are dark from speckling, exactly as in the *Pholas*.

A long, very active, thick, obtusely pointed foot protrudes from the opposite extremity of the shell, as if searching or penetrating downwards.

Colour of the shell grey and dingy yellowish,—of the animal white.

Water is squirted as from the *Pholas*, whence, perhaps, the vernacular name—Spout fish.

Dwells in the sand.

The animal seems to consist of a long white fleshy body, like the finger, extending at least two inches, which is closed in by the shell as it shuts. The whole shell seems lined with a fleshy investing substance, forming a wide arch about the middle, wherein the body hangs down. It is close upwards, and the shoulder with the orifices is invested by it above.

They thrust the foot so forcibly downwards that the whole animal is elevated.

It is very much of the nature of the *Ascidia*,—at least the upper portion.

The shell opens by a cartilaginous hinge, running down the whole back and uniting the valves. The front of the body is open from about the middle, the body there consisting of a thickish tunic lining each valve, and allowing the foot to descend. This foot seems to be chiefly occupied by a very dilatable internal cavity.

It seems very difficult to preserve these animals alive.

After being kept a short time, the edges of the shell recede from each other, which corresponds with the gaping of other bivalves, and this recession continues augmenting, from the weakness of the animal, until it perishes. It is not explained whether the creature's position in the sand is horizontal or perpendicular. Probably the latter, to allow the orifices to be free.

PLATE XVIII.

Solen nitida.

I shall abstain from further notes on the *Testaces* at present; nor, unless for the concomitant drawings of the animals, in vigorous animation, should so much have been said.

THE OYSTER FISHERY.

Perhaps the *Oyster* fishery merits a few observations, as of greater public interest, in an economical view, and especially from affording a number of people the means of earning a livelihood.

The oyster is abundant in various parts of Scotland, dwelling at various depth of water. I have been assured that there are oyster beds

V. III

PL. XVIII

Sten Stiqua
or
Shag Shell



on the shores of some of the Western Islands, dry at ebb tide, and are shovelled into carts to be carried away in numbers.

There are considerable oyster beds in the æstuary of the Forth, opposite to the city of Edinburgh, extending about sixteen miles, at intervals, to east and west, and partly within a mile and a half or less of the shore. The larger beds belong to the Corporation of the City of Edinburgh, to the Duke of Buccleuch, and the Earl of Morton,—all landholders in Mid-Lothian; and to several landholders in the county of Haddington.

The largest and finest oysters are taken in the vicinity of Prestonpans, nine miles east of Edinburgh. Towards the west they seem to be smaller and less valued. But the produce of the beds does not get time to grow.

The fishery under the control of the Corporation of Edinburgh is limited by special regulations, which are understood to be recognized by the other Mid-Lothian proprietors; as, I believe, the same fishermen, the inhabitants of Newhaven, are tenants of all three parties.

I have not discovered at what time this fishery was first turned to account; but, I observe that in the year 1732, a traffic in oysters was carried on between Leith and Hamburg,—whither they were exported in foreign vessels. Formerly the Scottish fisheries were chiefly engrossed by the Dutch, who seem, indeed, to have monopolised those of the whole world. About the preceding period they traded with England for the same purpose. Their vessels arrived here in January, June, and September.

This traffic still subsisted in 1740; but it is doubtful whether continuing long afterwards. However, the Magistrates of Edinburgh had to restrain the fishermen from dredging daily in 1751, and selling the produce to strangers, whereby the brood might be exhausted. Then they granted the exclusive privilege of fishing to a certain company, on condition of supplying the inhabitants with oysters at a more reasonable rate than previously.

It rather appears that the Newhaven fishermen had been allowed to take the oysters gratuitously, but they were afterwards prohibited from

selling to strangers without permission ; and the beds were let to them, in 1815, at £25 yearly. The rent fluctuated from that sum to £74, which was paid in 1838, and the fishery placed under certain regulations framed at various times. All shells under the size of a dollar were to be rejected as too small. This reference to a dollar rather indicates something more ancient, that the fishery had subsisted longer ; for, about two centuries ago, the value of many things was estimated in Scotland by dollars,—not by crowns or other coinage. Farther, the fishery was restrained by limiting the quantity to be taken by each boat, in proportion to the crew : 600 should be allowed for each man and the boat, 100 for each of the crew. Thus, a boat with four men might collect 2800 oysters in whole.

But many evasions were practised, and a trade carried on clandestinely, whereby the Magistrates believed the value of the fishery far above the truth.

About that time the whole was carried on by 250 men and boys, whose daily earnings I found, on fair calculation, at the time, would not exceed half-a-crown each.

Resolving to dispossess the fishermen, the Magistrates offered the beds on lease by public auction, and they were hired for £600 yearly,—the tenant being obliged to furnish the market with 10,000 oysters daily, at a certain price. Resolving to make the most of his bargain, he immediately equipped twenty-five sailing barks, it is said, each provided with six dredges and a competent crew. He scoured the banks incessantly, almost extirpated the brood, and exported the produce in cargoes.

But the fishermen were not to be dislodged so easily. They claimed an inherent right of fishery, which no one could infringe, broke out in open warfare, and trespassed on the beds, to add to this destruction.

They were driven forcibly off the ground, however, and some of them imprisoned. An act of Parliament was passed also for protection of the property.

But, now the new tenant prosecuted the Magistrates, claiming £30,000 for not having been preserved, as he said, in possession of the banks.

After a long and vexatious controversy, and much expense incurred, the lease was cancelled, and the fisheries are now let to the original tenants,—the Newhaven fishermen,—at £30 annually.

The Newhaven oyster fishery commences on the first of September, and terminates on the last of April; but, by special favour, it is now allowed to be carried on until the 15th of May.

Oysters are exported in very considerable quantities; and the beds are allowed too short time for recruiting the incessant ravages they are exposed to. They should remain untouched during a period of at least seven years.

Every place, however, is not alike favourable for the growth and multiplication of oysters, as may be inferred from repeated previous observations.

A good many years ago, the late Earl of Roseberry attempted to form oyster beds on the shores adjacent to his seat, Barnbogle Castle, a few miles west of Newhaven; but the project was quite abortive. The failure of a similar attempt, on the Yorkshire coast, is recorded in the seventeenth century. De Foe affirms, in his *Journey through Scotland*, which was published in 1723, that, at Hopetoun House, which is within five or six miles of Barnbogle, the owner had, "under his great terrace, a bed of oysters, from which his kitchen is supplied, all the year round, in the greatest quantities."—P. 207. I do not understand that they are now in any abundance.

Some years ago, being informed of a peculiar brood of oysters, near Chillingham Castle, belonging to the Earl of Tankerville, in the county of Northumberland, I felt desirous of ascertaining the facts. They were described as of remarkable size, and so highly valued that the bed was constantly watched; and, if some were collected, half-a-dozen would be considered worthy the acceptance of any of the neighbouring families.

Under these circumstances, I considered myself fortunate in obtaining eighteen!

These oysters are certainly very large—much larger than those obtained from the fisheries of the Forth, or any I had seen elsewhere. The

animals are thick, fleshy, of good colour, and fine flavour. But I could not discover any sensible difference, either in them or their shells, from the ordinary species. Indeed, I have recently understood that Lord Tankerville's oyster bed has been recruited from Prestonpans. The largest of the shells might be circumscribed by a circle of four inches and a half in diameter. They are tolerably clean, except for a few small marine animal or vegetable matter. The bed is described as very small, not extending above 200 yards : covered by about six inches of water at ebb tide.

On the whole, I am satisfied that their size and quality depend entirely on their site.

There is an extraordinary disproportion in the quantity of calcareous matter secreted and deposited by the different species of Testacea, especially by the bivalves, which are the more stationary. Sometimes the shell will be found many times the weight of the animal.

There is another product of the bivalves, concerning which something might be said, the origin of pearls. Small specimens are found in both the mussel and the oyster ; but especially in the fresh water shells usually associated with the former genus.

The Scottish pearls have borne considerable repute during centuries : they are alluded to repeatedly in history, as recovered from the shells of various rivers, in the north, the west, and the south. And the traveller may often observe quantities cast up on their banks, by adventurers in quest of their precious contents. Traders, also, sometimes bring their collections to the city of Edinburgh for sale. If memory serves me, the late Mr John Pinkerton had collected a number, among which he prized black pearls the most. One of the Scottish pearls is said to be now an ornament of the imperial crown.

Much has been said and written on the formation of pearls,—which, indeed, is a very interesting subject. Naturalists have patiently awaited for years the result of experiments designed to generate them.

Very few naturalists seem to have devoted their special investigations to the nature of the animals inhabiting shells. Undoubtedly, the

soundest arrangements of the *Systema* must repose on combining the history of the dwelling with that of its inhabitant; and, certainly, it must be deemed the more interesting detail of science.

If the precise place of some of the preceding bivalves be mistaken here, it may be partly ascribed to my desire to preserve, instead of hastening to destroy, the living animals.

CHAPTER IV.

MISCELLANEOUS.

LEPAS CYPREA (*Scaphellum vulgare* ?)—Plate XIX., Figs. 1, 2, 3, 4.

THIS animal was brought on the 23d October 1828. From its general nature it is of the same order as the ordinary Lepas.

The whole is about an inch and a quarter long, which may be considered as divided into two portions: the under half a cartilaginous peduncle, slightly corrugated; the upper half resembling a flat or thin hood, with a dilatable elliptical slit, about half an inch long, and opening an eighth of an inch, when the animal protrudes.

The exterior of the hood is variegated, dull white and brown: the peduncle dull white, semitransparent.

This peduncle is flexible, as the animal can turn the opening of the hood in any direction.

The animal protrudes about nine pair of feathered tentacula, of a pale carnation, the largest extending about half an inch.

The same alternate display and retraction of the tentacula is exhibited as in the common Lepas. When inactive the hood is closed, and probably the animal sinks down somewhat under it, to judge by what is discernible through the sides. For there seems a shortening of the portion within the peduncle, along with the animal's retrocession. As it rises the hood is opened, always widening as the plume protrudes from the labiæ, which are reddish within. The motion is slow and alternate; protrusion and recession not above eight or ten times in a minute.

VIII

PL. XIX.



Lepas-Balanus

The peduncle has a degree of flexibility, enabling the animal to turn the whole a little to one side or other. But how much has not yet been ascertained. As yet it has not exceeded the fifth part of a circle.

Generally, on the approach of light, the hood closes up. At first it did so even on the shade of the hand passing its glass.

The pale colour of the hood is diversified on either side by a dark brown stripe, arranged in two trapezoidal figures, and others of imperfect formation.

This animal is exceedingly rare.

This specimen is rooted on a *Tubularia indivisa*, near the bottom of the stalk. The *Tubularia*, to judge of the size and quality of numerous parasites, must be of considerable age, that is, at least several years. It has a fine flourishing head or coronal. Several minute *Sertulariæ* grow on the hood itself.

The feelers are cylindrical, consisting of several articulations of nine or ten divisions, projecting without the hood, and perhaps several within it. The whole are beset with slender spines; the longest are round the articulations. The extremity of the feeler is environed by about five spines, advancing considerably beyond it.

PLATE XIX.

FIG. 1. *Lepas Cypræa* (Scaphellum vulgare ?)

2. Feelers.

3. Single Feeler.

4. *Balanus*.

SERPULA CONTORTA.—Plate XX., Figs. 1, 2, 3, 4, 5, 6.

On the rocks east of Portobello, in the Firth of Forth, this animal is in uncommon profusion. These rocks are almost entirely destitute of all vegetation, nor is there any appearance of it on the shore. But, not far distant, are other rocks, on which are marine plants. The shells of these animals are conglomerated and arranged more irregularly on the surface of the lower part of the rocks, which are not dry probably before about half tide.

Perhaps they washed the shell until coming to a surface, as the apertures are all exposed. The animal is lively and active ; very timid, and withdrawing into its shell on the slightest motion. When undisturbed it remains with its numerous plumes unfolded, at the mouth of the shell.

Apparently they are of two species : the plumes of the one black and white, of the other pink.

A portion of rock, with several shells, having been out of water four days, I suspended it by a thread among some water : and, in an hour, I thought one animal was protruding itself ; but, after longer time, this seems doubtful. Small bubbles of air escaped from different apertures.

These creatures are generally of a greyish or greenish colour in the posterior part, and of a firm gelatinous consistence. Several spines are visible on each side of the portion corresponding in situation to the thorax. Is their use to retain the animal in its shell ?

At Queensferry, this animal is seen on the rocks, but it is not plentiful. Perhaps the species is different : as it seems solitary, or in very small societies, and the shell is much larger, and very white ; but I have not made particular observations on it.

On the 29th of September 1810, I took several of these animals, of different sizes, on stones at Queensferry. One was still alive on the 27th of May 1811, when it was lost in the confusion of moving from one house to another. I could not discover their food.

PLATE XX.

FIG. 1. Pecten covered with *Serpula*.

2. Oyster covered with *Serpula*.

3. Specimen removed from the shell.

4. The same, *magnified*.

5. Solitary specimen.

6. Branchial plume, *magnified*.



Serpula Contorta

CHAPTER V.

SPONGES.

SPONGIA FLUVIATILIS (*Spongilla fluvialis*).—Plate XXI.

ON the 8th August 1839, I procured this at Lochend, where I had seen something of the kind a number of years ago. The stones on the east side of the Loch I found encrusted with it, overspreading an area of from three to thirty inches. The substance is exceedingly fragile, incapable of resisting any force. The colour is of a dull dark green; but some are of a faint yellowish green.

It generally rises in low pyramids or thickened ridges, with numerous external orifices, seldom (at least at Lochend) exceeding one inch in thickness. The surface of almost all the specimens is scantily studded by minute yellow globules.

The ova are dispersed universally throughout the substance, many as low as I could cut it with a knife from the stone; but there they are paler and seem immature.

Two yellow ova, placed in a watch-glass, exhibited no motion; under the point of the knife, the shell cracked like an egg shell, and a more tenacious matter escaped among the water. Subsequently, among a number of ova floating in water, in different vessels, some seemed to

have a slight motion, but not sufficiently definite to admit of conclusions.

PLATE XXI.

- FIG. 1. *Spongia fluviatilis*.
2. Fragment with ova magnified.
3. The same, more highly magnified.
4. *Spongia eburnea*.



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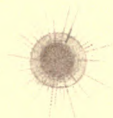
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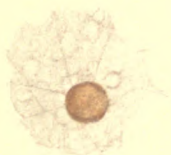
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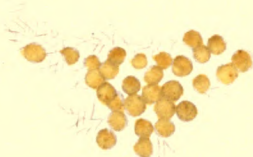
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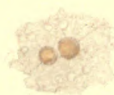
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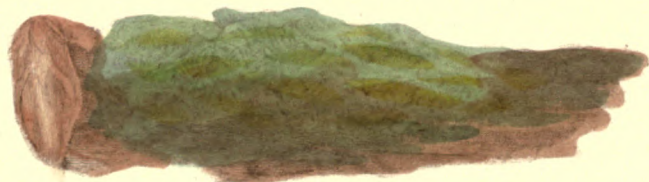
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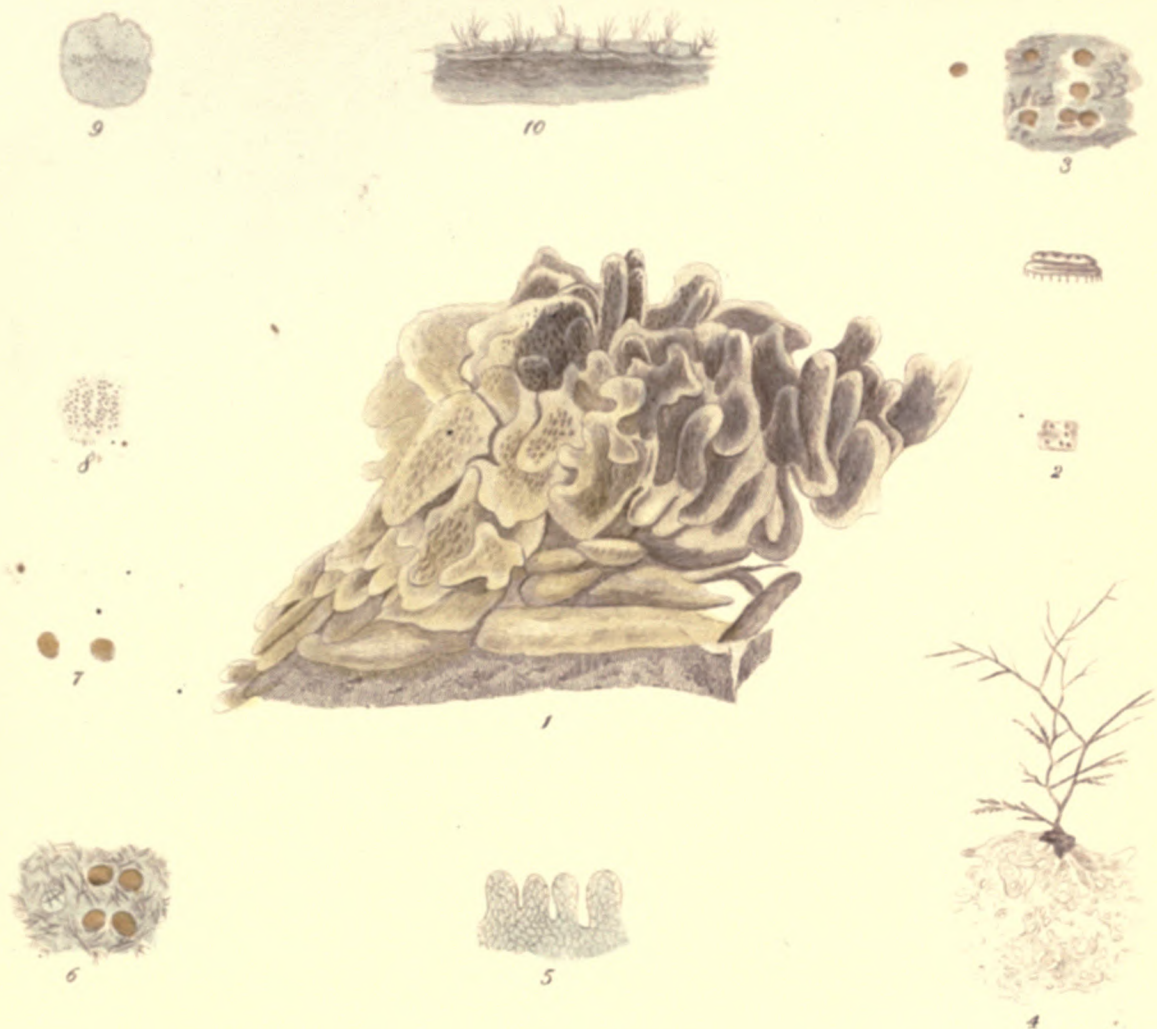


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Spongia attenuata.



Spongia fluvialtilis

SPONGIA ATTENUATA.—Plate XXII.

This subject was found in a pond by the roadside, near Craigleith, in August 1838.

This substance, I understand, invests stones, and separates in a stratum of an eighth of an inch in thickness. It is of a dingy yellow colour, much resembling a piece of chamois leather.

Numerous whitish spherules are dispersed throughout the substance. When suspended in water, they swim moderately, with a revolution in a vertical axis.

PLATE XXII.

FIGS 1.-17. *Spongia attenuata*.

SPONGIA MAMMILLARIS (*Halichondria mammillaris*).—Plate XXIII.

I cannot identify it with any in Dr Johnston's works ; but it may be analogous to the *mammillaris*.

This substance completely invested a valve of a shell, by a thick coating, completely applied to the outer surface and covering over the inner : so that, were it removed, it would form a perfect Scottish bonnet.

The external dimensions of the sponge are four inches by three and a half : the surface is convex, following the shape of the shell. From the surface about seventy of what resemble yellowish leather tags, somewhat flattened, and from eleven to thirteen lines high, and a line and a half across at the base. These tags rise out of the substance of the sponge.

A few ran within, from the portion turning over below, and some ran without.

The latter are farther prolonged within these three days ; and more slender a great deal than the tags above.

This is the *Spongia mammillaris* of Müller's *Zoologica Danica*, tom. iv. p. 44, plate 158. His specimen is infinitely inferior to mine ; but, he remarks, that his description was taken from it as preserved in spirits. He gives a general view of the surface, and a transverse section shewing the texture ; and comprises the description in two or three lines.

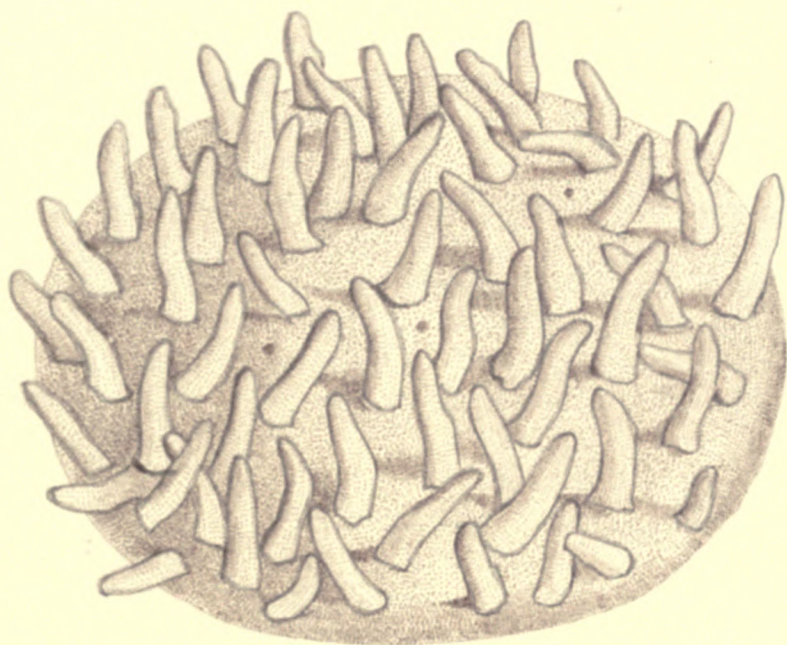
The mammillæ of my specimen resemble exactly the teats of a cow.

PLATE XXIII.

Spongia mammillaris.

VIII

PL. XXIII



Spongia Mamillaris

SPONGIA ?—Plate XXIV.

Perhaps this may ultimately prove of the same as I have already had in two specimens. It is rooted on a small shell of the *Venus Islandica*.

Height ten lines : greatest diameter about seven lines. Form exactly resembling a pear, affixed by the stalk, which diminishes to about a line in diameter where smallest.

The whole surface is rough, dingy white or greyish, like fine woollen cloth.

When inactive it stands erect ; the summit obtuse, round, and even.

But, when active, the skin opens and recedes from the centre. This exposes the yellowish substance below it, which is penetrated by a deep orifice immediately in the centre, and four large orifices in the yellowish substance around it.

The skin can close again, however, when the whole parts exposed are entirely covered up. I have not seen the skin recede so far as to show the exterior edge of the four orifices next to it.

These orifices are of rather irregular shape : they tend to circular. All are not of equal size : the central orifice is the smallest. Neither do they dilate equally : for two may be larger, and two of the four smaller ; or only one may be smaller.

This product forms a vortex, which whirls around the light substances on the surface of the water. Their motion is quite evident, shewing the vortex stronger at one time than at another.

Expulsion of internal air or water would have such an effect. If there is expulsion there must be absorption, for which no separate chan-

nels are visible ; at least we cannot ascertain what are the channels subservient to that office.

The position of the product is upright, quite vertical, or it lies over horizontally.

PLATE XXIV.

Spongia?

V.III.

PL. XXIV



Spongia

HALICHONDRIA OCULATA.—Plate XXV.

This specimen was brought to me in November 1832. It is six inches high, and spreading about six and a half inches. The utmost spreading of the root does not exceed an inch in diameter; and about an inch above it, the stem diverges into two boughs, the one larger than the other; each spreading into numerous parts, by successive subdivisions, and frequently terminating by a fork at the extremity.

The whole is of an umber colour, which, on drying, becomes of a dingy white.

This sponge is not very rare in the Firth of Forth.

PLATE XXV.

Halichondria oculata.

PLATE XXVI.

Cliona celata.

ADDENDA.



Halichondria oculata

UNIV. OF
CALIFORNIA

V. III.

PL. XXVI.



Cliona celata.



ADDENDA.

LISSOTRITON PUNCTATUS—*Newt or Eft.*—Plate XXVII.

AMONG the papers of the late Sir John, were found a plate and the following notes on the Water Newt. Though not in the proper order of the work, they are here presented, partly in accordance with what was known to be the wish of the deceased naturalist, and partly on account of their own intrinsic interest.

1848, *September 10th.* On the road from Morningside to Liberton, more than half-way turning east, there is a kind of marsh or pond, on the left hand going east, very near a large quarry, which is on the right hand. It is close to the road.

A quantity of collections, drawn by a rake from this pond or marsh, on the 8th, proved to contain three Newts.

1. One full grown.
2. A young specimen.
3. A small specimen, still bearing the branchiæ.

13th. In the morning a portion of the tail of No. 2 was mutilated : and now, in the evening, the whole animal has disappeared. It must have been devoured by No. 1.

15th. A number of the Squill, from Duddingstone Loch, taken on the 12th, having died, were put aside yesterday. Upon offering two of them to No. 1 this day, it devoured both immediately ; and on the 17th, it was observed to feed readily on them.

One being dropped into the water, the Newt inclines its head, gazing

at the dead animal, steals softly near, and then with a sudden snap of the jaws swallows it.

20th. This animal, No. 1, has become exceedingly tame. It readily approaches the side of its glass; and, yesterday, stretched up its head to take morsels of mussel from the end of a feather.

It is fortunate to find this substance acceptable, from the facility of obtaining it.

21st. The larger animal feeds from my hand, it is so tame.

23d. It ate voraciously of soft mussel to-day. The small one, No. 3, likewise ate another portion of it.

I took one yesterday, of the same species, in that pond or marsh before mentioned, about an inch long, which may be substituted as No. 2, for the lost one.

The smallest, No. 3, is under an inch in length. This smallest animal pounces on its prey like the other. The large one seems quite insensible of food if lower than the head. If higher, it advances very softly one foot after another; but, until almost in contact, never attempts to snap, when the food is seized in a moment.

October 4th. It feeds readily on the mussel, and is extremely voracious,—much more so than the two small ones. I remark it devours a great quantity at once; and never attempts to seize anything unless it be above its head. If a portion falls to the bottom of the vessel it seems to remain untouched.

25th. All three survive.

November 13th. The smallest died yesterday.

The other small one has never ate; but I could observe it swims as freely and buoyant with water as a minnow. It was delineated yesterday.

The largest is quite well: feeds readily, and is very tame—always coming to the side of the vessel on my approach.

20th. It eats voraciously, and comes very slily to snap at the food.

The eye is beautiful, it is quite circular. This creature was delineated yesterday.

22d. The feet of the small one are developed; some of the branchial apparatus remains. To-day it snaps at fragments of mussel.

V. III

PL. XXVII



Lissotriton punctatus.
Newt or Eft.

December 3d. To feed the large one is both tedious and troublesome. Cutting a thin narrow portion of the soft of a mussel, it is to be taken up or secured tightly in the rib of a feather of a quill, from which it may be easily detached; then it must be sunk in the water, and presented almost close to the mouth of the Newt,—rather higher than the mouth, a little on one side; the animal will approach very softly and snap at it. I could in no other way induce it to feed. The lower jaw opens downwards, very wide.

10th. The young Newt had a narrow escape. Some days ago a portion of mussel was introduced to its vessel, in expectation of its being strong enough to feed: this was neglected to be speedily removed, and, on the 8th, I found the Newt at the point of death.

It could scarcely move, though the water had no foetor; being immediately transferred to a vessel with water quite fresh, it recovered in twenty-four hours.

On the 12th I fed the larger one, which had become so extremely tame, and looked so innocent.

13th. This morning I conceive it had crawled out of its glass. I missed it at mid-day. But it had been found previously, and unluckily committed to a vessel of sea water, wherein, to my great regret, I found it dead.

It had been taken on the 8th September 1849.

PLATE XXVII.

FIGS. 1-4. *Lissotriton punctatus*, adult.

5. The same, young, with *branchia* still remaining.

The first part of the alphabet is the
vowel letters, which are the letters
that can stand alone as words. They are
the letters A, E, I, O, U, and Y. These
letters are the building blocks of words.
The second part of the alphabet is the
consonant letters, which are the letters
that cannot stand alone as words. They
are the letters B, C, D, F, G, H, J, K, L,
M, N, P, Q, R, S, T, V, W, X, and Z.
These letters are the building blocks of
words, but they must be combined with
vowel letters to form words.

The third part of the alphabet is the
numeral letters, which are the letters
that represent numbers. They are the
letters I, O, and X. These letters are
used in the names of numbers, such as
one, two, three, four, five, six, seven,
eight, nine, and ten. They are also used
in the names of the months of the year,
such as January, February, March, April,
May, June, July, August, September,
October, November, and December.

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